JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL,

EDITED BY

THE SECRETARIES.

VOL. XVI.

PART I.—JANUARY TO JUNE, 1847.

" It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science, in different parts of Asia will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish if such communications shall be long intermitted, and it will die away if they shall entirely cease."—SIR WM. JONES.

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PART I.

INDEX TO NAMES OF CONTRIBUTORS.

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PART I.

ERRATA.

Part 1st.

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301	12	for Triunba read Trúmba.
,,	19	for Sherí at el Beitha read Sherí 'at el Beitha.
302	4	for Tarimyer read Tarmíyeh.
,,	12	for Jeddiah read Jedídah.
,,	18	for Jeddiah read Jedídah.
303	10	for After "When it bore East" read On the right bank, &c.
,,	17	for Khiyat read Khayt.
,,	24	for Jeddiah read Jedídah.
,,	3	for (in note,) Keif read Kúf.
,,	6	for Nhar read Nahr.
304	8	for bending read trending.
,,	18	for Dojin read Doj'm.
,,	3	of note, Seghimeh read Seghirmeh.
,,	4	for Sir read Sú, and for Tau read Táúk.
,,	67	for Hamria read Hamrín.
,,	11	for Hamrool read Hamrín.
,,	13	for Physens read Physcus.
,,	,,	Last of note, Opio read Opis.
305	23	for Daláhee and Lagros read Daláhú and Zagros.
,,	24	for Malwujep read Malwíyeh.
306	28	for approached read approach.
,,	29	for was read is.
307	1	for Síel el Azeez read Sid 't Azeez.
308	3 & 5	for Maluryeh read Malwíyeh.
309	9	for passing read passes.
,,	25	for Malwújeh read Malwíyeh.
313	19	for Hebla read Kebla.
315	3	for round read mound.
,,	6	for Shiragoor read Shirazoor.
,,	2	of note, "Ustrima" read "Ustrina."
,,	13	for Sammariah read Samarrah.
,,	18 & 22	for Dina read Dúra.
,,	28	for Sammariah read Samarrah.
316	19	for this read thus.
,,	24	for present read personal.
317	9	for Yet alíj read Tel alíj.
,,	10	for Apis read Opis.
,,	22	for Mahrwan read Nahrwán.
,,	24	of note, for it read is.
,,	29	for Zellar read Tellúl.
,,	37	for Malwryeh read Malwíyeh.
318	17	for had read hove.
319	16 & 17	for after the numerals ° and not t.
,,	16	for Mahirgeh read Malwíyeh.

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319	21	for Abri Delif & Maluryeh read Abú Delif Malwíyeh.
,,	24	for Majainmah read Majammah.
,,	25	for On the east side, &c. read On the east side.
,,	26	for Mahrwan read Nahrwán.
322	12	of note, for analysis read anabasis.
,,	23	for M. Batta read M. Botta.
323	12	for Asperiall read Aspinal.
,,	21	for "Durn" read "Dum."
325	25	for Tekriths read Tekritlís.
326	11	for "Al'arab" read "Al'Arab."
,,	14	for Tekrith read Tekritlís.
,,	24	for a Scorpii read α Scorpü.
,,	13	for Khanisah read Kanísah.
327	2	for Arnin read a ruin.
,,	3	for Kamsah read Kanísah.
,,	4	for "El Tet'bha" read "El Fet'hha."
,,	6	for S. W. read N. W.
,,	4	of note, for (Tageit) read (Tagrit).
328	1	for easting read casting.
,,	13	for Khalidj—fresh sentence, Observing, &c.
,,	24	for Extending to the Eastd. read Extending to the Eastd. from it;
,,	1	of note, for "E. Seliva" read "El Selwa."
329	2	for Mejiris read Nejiris.
,,	,,	for Nejin read Nej'm.
,,	6	for gazing read grazing.
,,	8	for tints read tents.
330	6	for "El Tettha" read "El Fet'hha."
,,	9	for Makhal read Mak'húl.
331	31	for Maluryah read Malwíyeh.
,,	34	for Tholush read Tho'líyeh.
332	11	for Trumbee read Trúmba.
,,	12	of note, for Al Athus read Al Athur.
,,	14	for Bukhtyari read Bakhtiyárí.

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614	16	for POTAMIDA read POTAMIDÆ.
621	23	for *biporcatus* read *porosus*.
623	note,	for *Geckotidæ* read *Geckonidæ*.
643	3	for on the Pinang read in the Pinang.
656	5	for *Polycopodium* read *Polypodium*.
909	14	for $3\frac{3}{8}$ inch read $0\frac{3}{8}$ inch.
921	30	for HEXAHONOTUS read HEXAGONOTUS.
927	6	for *catenularies* read *catenularis*.
929	5	for Dryiphis read Dryiophis.
1066	11	for *twelveth* read *twelvth*.

JOURNAL

OF THE

ASIATIC SOCIETY.

JUNE, 1847.

On the Local and Relative Geology of Singapore, including Notices of Sumatra, the Malay Peninsula, &c.—by J. R. Logan, *Esq.*

[The following paper was sent to the Asiatic Society of Bengal in January 1846. The delay which has taken place in its publication in their Journal, enables the writer to append an extract from a letter to Professor Ansted, in which he has given a summary of the results of his subsequent observations made in localities more favorable for geological inquiries than those to which his attention had been confined when the paper was written. It may save the reader some trouble if he be furnished at once with the key to the theoretical discrepancies which may be noticed between the paper and the letter. He thinks it better to do this, and to leave the former as it stands with all its faults, rather than to alter it in conformity with his more matured, but still imperfect, views. The geology of every fresh region has to be worked out amidst doubts and errors, and a record of the stages through which its theory, if at all new, passes in its progress towards complete truth, may often serve ultimately as its best demonstration, because it will show that it was not hastily adopted, but gradually grew out of a long continued and defeated effort to assign to every new phenomenon a place in familiar systems.

The principal result at which the writer had arrived when the paper was written was the opinion, advanced hypothetically in it, that the southern extremity of the Peninsula, &c., had been ruptured and upraised by subterraneous forces, and that through the rocks so affected

ferruginous gases, &c., had been emitted. The action of these gases on the rocks had, amongst other transformations, produced laterite. The paper was written under the impression that the formatiou of plutonic rocks and plutonic action in sedimentary rocks were confined to deep subterranean levels (see the writings of Mr. Lyell and other English geologists). Hence it seemed necessary to believe that the superficial igneous action with which the paper was mainly concerned, was wholly unconnected with the granitic and other plutonic rocks of the district; subsequent investigation of some of the best developments of these led to the conviction that the *Tartarean* theory was inapplicable to them at least. The disturbed sedimentary rocks were re-examined free from the bias of that theory, and it then appeared, that, while the evidence in favour of the metamorphic origin of the laterites, &c., was so strong and varied that it might be now recorded as a demonstrated fact; there were no apparent obstacles to the reception of the simple hypothesis that they were caused by plutonic agency, and that the plutonic rocks of the districts were themselves the agents of the alteration or the effects of one and the same hypogene agency. This hypothesis embraces at once the whole region of elevation in which Singapore is situated, with all the plutonic, volcanic and metamorphic phenomena which it exhibits. It refers the whole to one cause operating throughout a long period of time, and which has not yet entirely ceased to operate, as the volcanic emissions of Sumatra and the vibrations of the whole region, from time to time, and the thermal springs of Sumatra and the Peninsula, constantly testify to us. This cause is the existence of an internal plutonic intumescence, or nucleus, which has slowly swollen up, fracturing the sedimentary strata, saturating and seaming them with its exhalations, and as it forced itself up beneath them and through the gorges and fissures, at once upheaving them and feeding on their substance, till, in many places, it pressed and eat through them to the refrigerating surface, and rose, congealing, into the air or sea. It is this latter circumstance that distinguishes the region from all those which have been observed by European geologists, and it is this singularly high level which the plutonic reduction has reached that explains the extraordinary appearances which the unreduced superficial rocks have so often assumed. The metamorphosed rocks of Europe evinced a deep subterranean saturation with plutonic exhalations, and European

geologists concluded that plutonic action was necessarily deeply subterraneous. But here, I think, we find a subaerial or subaqueous plutonic activity; and where the plutonic level has not reached that of the pre-existing rocks, a new kind of metamorphism appropriate to the new conditions under which the plutonic exhalations have operated.

The interest which the discussions respecting laterite have given to that rock, tends to invest it with undue importance geologically. The ferruginous emissions have affected all rocks indiscriminately, and their action on sandstones, grits and conglomerates is as well marked as that on clays, marls and shales, although the latter only produces proper laterite. Even in the clays, laterite denotes one only of many degrees and forms of alteration. To express the origin of these rocks and its unity, to record the cause of the difficulties which they have presented, and to distinguish them from true metamorphic rocks, I would propose, avoiding any new technical names, to term them simply the *iron-masked* rocks of the Indo-Australian regions. This term will include the principal or plutonically ferruginated rocks, which, without being either completely reduced or metamorphosed, have been either wholly disguised or partially altered by ferruginous emissions, which have saturated them in the mass,—or only affected them in fissures and seams,—or been interfused between portions of the rocks not actually separated by fissures, but intersected by planes of mere disconuity, the sides of which have an imperfect cohesion, or having a common border of inferior density and increased porosity caused either by interruptions in the original deposition of the matter of the rock or by unequal stretching or incipient cleavage. The term may be also extended, perhaps, to those sedimentary beds in which the iron saturation, although coeval with the deposit of the other constituents of the rock, has served to obscure or conceal their true nature as well as the derivation of the beds themselves. These beds appear to have been sometimes formed by superficial layers of gravel, &c. being permeated by iron solutions. With these must not be confounded the broad bands lying over and beside the heads of iron-masked dykes, and which, having been in a loose gravelly or fragmentary state at the time when the plutonic emissions passed through them, became cemented into hard, and occasionally scoreous, ferruginated conglomerates, &c. and are therefore proper plutonically iron-masked rocks.]

Before entering on a detailed account of the mineralogical features of Singapore, it will be convenient to bring into a preliminary paper some discussions of a theoretical nature, which, if not thus separated from the former, might, in the sequel, occasion frequent interruptions and some confusion. A brief sketch of the topography of the Island will suffice as a basis for the remarks which follow it.

The Island is of an irregular figure, when correctly laid down, (for the published maps, with the exception of Mr. Thomson's, are very incorrect,) resembling a bat, the head being at Tanjong Sinoko, in the old strait, the tail at Tullah Blanga, or rather Blakan Mati,—the western wing being fully expanded and the eastern a little retracted. Its greatest length from Pulo Campong or Point Macalister, on the west, to Tanjong Changai on the east, i. e. between the tips of the wings, is 21 miles. Its greatest breadth from T. Sinoko to T. Blangah coast, i. e. from the head to the tail, is 12 miles. Its superficial extent is roughly calculated at 200 square miles.

The town of Singapore, to start from the best known point, is situated at the south-western extremity of a flat alluvial tract, of which the greatest length in a straight line near the sea-beach is about 6 miles, and the greatest breadth inland about 2½ miles. Three well marked deposits occur in this flat. A stiff clay of a greyish hue, becoming in some places darker and even blackish; a whitish, greyish or yellowish sand; and a vegetable deposit, consisting, where most recent, of fragments of wood or masses of aquatic plants more or less decomposed, and, where older, of a soft peaty matter passing into a black mud. The mode in which these beds have been deposited will be described hereafter. The west side of this plain is marked by low rounded hillocks, separated by openings on the same level as the plain. On following these in a northwesterly direction, the former are found to be the extremities of distinct ranges of hills, and the latter the mouths of valleys between them, the principal extending about six miles inland. The largest valley, along which there is a public road, terminates a little to the south of a group of hills called Bukit Temah, the summit of which is 530 feet above the level of the sea, and the highest point in the Island. From this group the valley and the stream which drains it borrow their name. The coast of Singapore to the S. W. of this valley also follows a N. W. direction. The intervening space is occupied towards the sea by a

prominent range of hills rising abruptly to a height of 300 feet at Tullah Blanga, which has lately been made the signal station. Towards the Bukit Temah valley a broad irregular range of hills is united apparently with the Tullah Blanga range on the N. W., and as it proceeds the S. E. separates from it and gives room for a broad swampy flat, from which the Singapore River flows. Nearer Town the range bifurcates, one of the forks terminating in Government Hill and the other in Mount Sophia. These Hills approach close to each other, but proceeding inland the two divisions of the range draw further back, and a secondary valley of considerable breadth, and about two miles in length, is formed. The range on the N. E. of Bukit Temah valley springs from Bukit Temah, and terminates in a low broad sandy elevation which slopes almost insensibly till it emerges in the plain. It is in some places about 1½ miles broad. The configuration of the range,—and most of the others have many features in common with it, may be partially observed in proceeding up the Bukit Temah valley. A succession of low hills present their rounded ends stretching into the valley which expands into the concave or sinuous hollows between them. The lateral valleys thus formed are of various figures and extent. Many resemble a horse shoe or amphitheatre. The upper extremities of most are of this shape, and similar indentations occur in the course of the more protracted, at the necks connecting the different hillocks which form their sides. When we strike across the range we are at first confused by the number of hillocks and hollows only partially cleared of jungle; but under patient observation they gradually assume a certain order; about the centre of the range the ground is a comparatively elevated and broad tract, but very irregular in its configuration. All these irregularities however, it is probable, have relation to the lateral ranges. These are seen to branch off to the north and south in a series of hillocks joined to each other by their sides and sometimes by an elongated neck. Towards the valley they often bifurcate, one limb sometimes taking a direction parallel to the range and then sweeping round and expanding into one of the broad hillocks whose ends approach the public road. The peculiar character of the topography of the country arises from the multitude and individual smallness of the hills, and the circumstance of the valleys which penetrate between the principal ranges and their branches, being, except towards the centres of the ranges, per-

feetly flat, and very little above the level of the sea, so that the winding outlines of the bases of the hills are nearly as distinctly marked as if they sunk into the level sheet of a lake. We have in fact regular mountain ranges in miniature, and so symmetrical with all the apparent irregularity, that if the highest or summit lines of the ranges and their lateral members were correctly laid down on a map they would present no remote resemblance to the section of a tree. Beyond the last mentioned range another long valley occurs.* The stream Balastier which flows through it has its rise in Bukit Temah. The further or N. E. side of this valley is formed by the Kallang range of hills, the upper extremity of which is also connected with Bukit Temah : its lower division is penetrated by a long secondary valley. One of its summits rises considerably above the general level of the hills. Beyond it the valley of the Kallang river stretches inland. This valley has not been examined up to the top, but it is believed the river rises to the north of Bukit Temah in a continuation of that range. All the preceding ranges terminate in the plain or to the west of it and the Kallang, Balestier, Bukit Temah and Singapore rivers all cross the plain, converge towards the town, the three former uniting their waters, and flow through it. The next range beyond the Kallang valley is the central range or backbone of the eastern part of the Island. It does not terminate at the line where those already described sink into the plain, but continues its course to the eastward, sending out lateral ranges, the southern and western extremities of which form the boundaries of the plain. This range terminates at the Red cliffs. All the hills on the east and N. E. sides of the Island appear to be expansions of it. The valleys between the lateral ranges are bolder and deeper than those in the ranges first described, owing to the hills being generally higher and steeper. This range is connected with the Bukit Temah range. In its central parts it displays broad undulating tracts on a larger scale than the other ranges. Amongst the multitude of valleys which its branches include there is one on the northern side of some size in which the Serangoon stream rises. This valley seems to be a peaty swamp. It passes into a broad tract of mangrove jungle where the stream is lost in a creek which opens into the old straits of Singapore. Other streams fall into the straits

* For much information respecting these difficultly accessible valleys I am indebted to Mr. Thomson, the able and indefatigable Surveyor to Government for the Straits.

from this range. This principal is the Soongie Saletar, which appears to flow through a long valley between a branch of this range and another range proceeding from the Bukit Temah group in a northerly direction. The western side of the Island consists of several ranges radiating apparently from the Bukit Temah group, and penetrated by valleys, some of them, such as that of the Kranjee, which flows northward to the old strait, and the Joorong, which flows southward to the Salat Samboolan, being of considerable length and terminating in broad creeks intersecting mangrove swamps. Between some of the ranges the only wide flattish tracts in the Island which are not alluvial are found. The lower parts of the valleys are mostly swampy, consisting of sand, clay and black peaty mud, of the latter there are considerable tracts constantly moist and exhibiting an extraordinary rankness of vegetation. Looking on one of these swamps covered with tall but slender trees, and dense underwood growing up rapidly, and from the looseness of the deep bed of black vegetable matter,—the accumulated remains of their short-lived predecessors,—destined soon to fall in their turn, and considering the deposits of clay and sand which accompany and give rise to it, it is impossible to doubt that we see nature repeating the precise process by which the materials of most of the ancient carboniferous strata were brought together. Towards the sea these forest marshes give place to mangrove swamps. An intelligent Chinese Gambier planter compares Singapore, not inaptly, if the eastern part of the Island be excluded, to an open umbrella, of which Bukit Temah is the top and the various rivers the ribs. If we suppose the Island to have been formed of a somewhat brittle material, and a strong blow from beneath to have struck it at Bukit Temah, from which cracks radiated in different directions, dividing or bifurcating in their progress, a rude idea of the lines of hills may be formed; or if we view the Island from west to east our old comparison to the section of a tree would serve us best. Bukit Temah and the adjoining hills form the stole from which one main trunk, about 12 miles in length, extends to the Red Cliffs with numerous branches. Several smaller trunks rise on the south side of the main trunk and extend for about 6 miles in a S. E. direction, also sending out a multitude of small branches. To the west the roots radiate to different parts of the coast, the tap root being about 7 miles long.

The hills of the first and second ranges in the order in which they are above noticed consist chiefly of sandstone (fine grained, gritty and conglomeritic) and shale strata. Towards the eastern extremities of the two next ranges similar rocks are observed. Further on soft clays of various hues, but mostly mottled white and red or purplish, passing into a soil of different shades of red, yellowish red, and brownish red, are observed near the surface, and occasionally protruding blocks of sienite and green-stone occur. The hills of the eastern side of the Island seem to be principally sandstone with slight traces of shale. The western side is also for the most part sandstone and shale. At the N. E. extremity granite or sienite appears and it is also seen at several places along the N. and N. W. coast.

The superficial deposits which occur at various places are very remarkable. On some hills a red stiff clay resembling laterite is found. On many, imbedded in clay of different red and brownish hues, in irregular sheets or in thin seams, occur blocks of a ferruginous clay, rock or smaller stones and pebbles of various kinds and sizes. These will best be described hereafter by selecting particular localities where they abound.

I now proceed to notice the different hypothesis that have been or may be suggested to account for these appearances. Of the alluvial plains and valleys which ramify through the Island in all directions I need say nothing here, as they, in exposed beds at least, have all or nearly all been formed subsequent to the hills and their superjacent deposits, and are separated from the latest accessions of matter which these received at a period when they formed a multitude of little bays and long narrow inlets of the sea.

The first class of the hypothesis that may be offered in explanation of the superficial formations of Singapore, embraces those that contemplate merely the position, external appearance and size of the detached rock fragments.

1.—Alluvial Hypothesis.

Of these the first supposes the blocks, gravel, &c. to be the debris of older rocks deposited in the sea before the extrusion of the hills. If it be conceived that the elevation of the hills above the level of the sea was the same act with the protrusion of the strata of which they

are composed from their previous horizontal bed to their present inclined position, we are met by the fact that the superficial deposits are not in layers conformable to these strata, but are spread over their uplifted edges. If again, it be supposed that the hills were formed under water, and that after the accumulation of the gravel, &c. upon them, the platform from which they rise was elevated so as to cause them to emerge from the sea, we are met by other insuperable objections. Of these it is only here necessary to specify one, although looking to single limited localities the gravel deposits appear to be regularly disposed like beds derived from currents; when we compare one hill with another we observe far too much irregularity to allow this idea to be tenable.

2.—Diluvial Hypothesis.

As we extend our observations this irregularity is seen to be so great that we are irresistibly led to conjecture that its causes were diluvial instead of alluvial. In many places rock fragments of all sizes are confusedly intermixed with loose clay or sand, so that if due to aqueous action it must have been of an extraordinary and violent nature thus to have borne along rapidly masses of matter containing large blocks, and deposited them in such confusion, and that often on the summits of hills. A continued diluvial action of variable force might also account for the large quantities of rounded pebbly-looking stones, and the broad thin beds of smaller gravel-like stones that occur. Closer investigation however seems to discover an unanswerable argument against a diluvial theory in the fact that the larger rock fragments, and even the gravel, differ in different localities, often even when these adjoin each other, and that it has always been found that they have a certain correspondence with, or relation to, the subjacent rocks where these have been exposed. No decided boulder or drift has yet been noticed.

Colonel Low appears to have considered the scoriaceous, ferruginous rocks as boulders, but he gives no reason for this opinion. The gravel he refers to the concretionary tendency of soils impregnated with iron. I need not stop here to remark upon these evidently hastily formed views.*

* I cannot mention Colonel Low, during so many years of official toil, almost the solitary votary of science and oriental literature in the Straits Settlements, without expressing the hope that he will not long withhold from this Journal the fruits of his present "learned leisure."

3.—Decomposition of Rocks in Situ.

This, which is the hypothesis that next most naturally arises, would embrace many of the facts that are inconsistent with the sedimentary and diluvial suppositions, such as the local character of the rock fragments. The outcrops of the strata, which are generally highly inclined, would under meteoric influence, down to a certain line of depth which would descend with the denudatiou of the surface, suffer different changes according to the nature of the rock. The harder sandstones and shales would, split and break down into irregular fragments. The softer sandstones, clays and shales,—and of the latter especially the finely laminated beds,—would, under the combined chemical and mechanical influences of the air, raiu, rapid transitions of temperature, &c., lose their distinctive original characters and gradually become uniform masses of sandy or clayey soils. Every heavy fall of rain would wash away the more superficial particles. According to the declination of the sides of the hills, fragments of rock of different sizes would be carried down by the pressure of water-moved soil and gravelly fragments. Where the hills were steep, larger blocks, from the gradual loosening of their beds, would descend to lower levels by their own gravity assisted by similar pressure from above. The summits and ridges of the hills would be most exposed to the action of sun and rain, but generally least so to the denuding power of gravity. Where the soil was loose sand, or where there were narrow summits, the process of denudation would be more active than elsewhere. The soil as it was formed would disappear, and only fragments of rock be left where the latter was of a nature to yield with difficulty, slowly and superficially to decomposition. Where the fragments pulverized more quickly, some soil would generally be found, always drawing additions from the rocks, but always a prey to the rains.

These considerations certainly explain the present appearance of many of the hills, and in every locality phenomena occur evidently due to the forces of which I have been writing. Ridges and summits are often found consisting almost entirely of rock fragments, aud it might seem that these forces alone would be adequate causes for their occurrence. But on hills with extensive flattish summits, beds of fragments, sometimes large,—sometimes of all sizes mixed—sometimes uniformly small and gravel-like, lying under or in the soil at various depths, from

an inch to many feet, below the surface, are frequently discovered by sections for roads and pits for planting spice trees, &c. It is obvious that the hypothesis which I am now considering will not explain such cases.

There is another phenomenon of frequent occurrence connected with the position of fragmentary rocks which this hypothesis ought to include if it be made the foundation of any general theory. In sections across strata they are almost invariably seen to be more or less curved as they approach the surface. Before reaching it however they sometimes gradually, but often abruptly, lose their compact form and become masses of fragments. In some cases these are almost insensibly mingled with the superincumbent soil till all trace of the stratum disappears. But it is not uncommon to see the curve pass into a line more or less horizontal, and even bent downwards, and the fragments streaming away as it were in a layer of which the direction seems to have no relation to the parent stratum, but which generally possesses or approaches to parellelism with the plane of the surface. It is true that of some of these cases the hypothesis which we are at present pursuing might seem to afford a solution. Thus suppose a thin layer of hard sandstone to rest on a bed of soft sandy clay or unlaminated shale, both inclined and having their outcrop on the slope of a hill, a certain depth from the surface of the slope would be subject to the action of meteorie forces which would cause the sandstone to break up into fragments and the sandy clay to become loose and open. The sandstone rubble, if heavy, might possibly tend to descend or settle in a perpendicular line *through* the upper pulverulent to the lower and more compact soil, and, at all events, as the soil below it was carried away, the rubble would descend along the line of the slope, the heavier fragments remaining at and near the point of outcrop, those of medium size streaming further down the slope, and the smallest borne away with the fine sand and clay to lower levels;—the possibility of the existence of such lines of rubble, their breadth down the slope from the line of outcrop, and the quantity and size of the fragments, being always determined by the texture of the recipient bed of clay or sand, and the declivity of the hill. Where the slope of the hill consisted of a succession of similar layers and beds, the lower layers of rubble would, in course of time and in favourable positions, become covered with soil brought

down from above. There are undoubtedly cases which, if taken by themselves, this explanation will satisfy. But when we seek to convert this hypothesis into a general rule we are at once met by numerous discordant appearances. Thus, of the extensive layers of rubble or gravel-like fragments beneath a thick bed of clay which, as before mentioned, are found on broad even summits of hills and ridges, there are many where the clay is too compact and aluminous or the rubble too fine, for the latter to have descended from the surface of the former, and where there are no adjacent higher levels from which the former could have been degraded and superimposed upon the latter. There are other allied cases too which simple atmospherical causes will not account for and which bring us to the next hypothesis—that of

4.—EARTHQUAKES.

The instances alluded to are where the heads of the strata are not merely converted into rubble and bent in the line of slope, but where they are in zigzag, crooked, or sinuous lines;—where adjacent layers are differently and irregularly deflected out of their planes; where the rubble is here in large pieces lying in the direction of the proper plane or of a regular curve from it, and there shattered into a confused mass of small fragments, sometimes much thicker and sometimes much thinner than the unaltered layer itself;—or where fragments of one layer are intermixed with those of an adjacent one, detached pieces of a sandstone layer for instance imbedded in a layer of clay above it, or portions of both layers confusedly mingled till all trace of their lines of demarcation is lost.

It is clear that no ordinary mechanical operations caused by atmospherical forces could have produced such results, and that violent convulsive movements of the earth have left these records. In the slight earthquakes felt at Penang in 1843 it was remarked that the residents on the hills described their effects differently from the residents on the plain, or in language more exaggerated. In Belmont-house, which is situated an the summit of a peaked hill rising freely out of the Pentland chain, the tremor was particularly strong. Upon general mechanical principles it is evident that the shocks will be most severely felt wherever the rocks acted on are freest. Through a dense homogeneous mass extending uniformly in all directions equable undulations and vibrations

may pass without disturbing the internal arrangement, because the motive force will meet with an equal resistance throughout. But where the mass acted on suddenly changes from a dense to a lighter rock, fractures and other internal disturbances will follow according to the intensity of the force, and where the mass of rocks is met externally by the rare elastic mass of the atmosphere, the resistance in that direction being removed *per saltum*, the general centrifugal tendency which will be impressed by the nether forces, even when their proper direction is more horizontal than vertical, will cause the upper rock to a certain depth to be fractured, loosened and expanded, the external fragments and particles being perhaps quite free and even projected. In this condition the whole superficial mass will readily yield to continuing vibratory action, and any or all of the phenomena above described may be the result. It is a further argument in favour of mechanical convulsions of considerable violence and irregularity, that although the general dip of the strata of Singapore be from westerly to easterly, cases are found of a hill resting on the same apparent base with an adjoining one where the general rule operates, having its strata inclined from east to west, and even in the same hill particular sides or outlying ridges or spurs, present deviations both in the direction and in the angle of the dip.

5.—Volcanic Action.

Hitherto we have remarked no phenomena that may not be referred to the ordinary mechanical or chemical forces acting at the surface of the earth, or to critical mechanical disturbances. But I have now to notice a large and varied class of facts which require different forces to be introduced. These facts are so numerous, so constant in their occurrence over every part of the Island which is open to examination, and not less than elsewhere in those parts from which the observations of writers on the geology or mineralogy of Singapore have been drawn, that it is difficult to conceive through what fatality they have hitherto, for the most part, escaped notice or been passed over as unimportant. The most obvious of these facts are dykes and veins of igneous rocks, masses *in situ* and scattered fragments of rocks, such as sandstone, clays, shales, granite, &c, altered by the action of fire ; rocks in veins and joints often highly indurated, whereby sandstone has acquired sometimes a cellular structure, and at other times externally a honey-combed

appearance; congeries of curved, zigzag and radiating veins in sandstone, clays and shales, filled with crystallizations, and both from their own appearance and the alteration in the rock in which they are found showing chemical or electrical action of a volcanic nature; the presence of sulphur accompanying anthracite in shales denigrated and rendered fuliginous by fire; the slaggy appearance of many rocks and fragments which are often covered externally by a shining black, bluish-black, or dull iridescent varnish or glaze; the scoreous appearance of others, many being mere cinders; the abundant presence of oxides of iron, and particularly their intensity in those places where the other evidences of igneous action are most marked, and their absence where these are entirely wanting. It is impossible to refer these facts and others of an analogous character, which will be mentioned in a future paper in the description of particular localities, to any but volcanic causes. The reddish, reddish-brown and reddish-black rocks which are found so abundantly have been noticed by Lieutenant Newbold, Colonel Low and others. The general name of laterite has been sometimes applied to them. Colonel Low uses the terms "iron clay," "iron stone" and "iron ore." The red soils have been in like manner called laterite or iron soils. Both terms appear to be objectionable. Laterite is a particular species of ferruginous clay which indurates on exposure to the atmosphere like many other rocks: it ought to be restricted to the clay to which it was assigned by Dr. Hamilton, and not indiscriminately applied to every new rock strongly marked by oxides of iron. With respect to the term iron clay or clay iron stone, it has not yet been shown that any of the proper argillaceous iron ores, into the composition of which carbonic acid enters so largely, are found in Singapore. If there are any they have been disguised and changed by heat, decomposing into peroxides. The fact however is that these so called laterites and iron ores, externally as to colour and form differing little if at all, prove often on examination to be only fragments of the common stratified rocks, sometimes calcined, sometimes indurated, and sometimes partially fused by heat. We cannot therefore resort to a prevalence either of laterite or iron ores to explain the geology of the Island, and are by the rocks, which have been so designated, led back to volcanic causes.*

* *Laterite.*—Many of the clayey hills here appear to me to be decomposed sienite, sometimes unaltered by supervening volcanic action, but generally partaking in the metamor-

Such a comparatively small portion of Singapore has yet in any way been laid bare, and of the accessible parts, with certain exceptions, so little is open to inspection save the mere surface, that had my examination of the most favourable localities of the latter been much more minute and careful than it has been, I should still have hesitated to combine the results into any general hypothesis. But as such an hypothesis has been forced upon me while following up my inquiries, and no facts have hitherto been noticed to which it is irreconcileable, I shall endeavour to explain it, leaving to future observations to build it into a theory, or reject it as a fancy. And as I shall proceed in subsequent papers to furnish detailed accounts of different localities, the reader will be enabled to draw his own conclusions.

The general direction of the elevatory force to which the hills of Singapore and the neighbouring Islands owe their origin, was from W. by S. to E. by N. since their dip is generally in or near that direction. Although the undulations or upheavings had this general tendency, the causes to which they were due must have been of a somewhat irregular

phism which the matter of most of the elevated land has suffered from that cause. May I venture to suggest that the hypothesis which is developed in this paper for Singapore might, if applied to the laterite of India, perhaps explain its origin, and, in doing so, to a certain extent also reconcile the conflicting opinions that have been maintained regarding it. All that I have read of the great laterite formations of the south of India, and which extend to the heart of Bengal, where they are described by Dr. Buchanan, leads to the conclusion that they do not consist of purely volcanic, sedimentary or decomposed matter, but what I have termed semi-volcanic. The same formation is found at Malacca and analogous deposits at Singapore, and both inseparably associated and evidently contemporaneous with altered rocks of the kind previously noticed. If we conceive an area with trap, granite, sandstone, shale, &c. exposed at the surface (in the atmosphere or in the sea) and partly decomposed or disintegrated, to be subjected to a peculiar species of minor volcanic action like that which is described in this paper (*the distinctive phenomenon probably of one and the same geological epoch*) the result would be that, with the occasional exception of matter ejected from no great depth, and some dykes and veins, the previous soft surface rocks would be merely altered or metamorphosed by heat and impregnated with iron, derived perhaps from the basaltic and other ferriferous rocks through which the discharged steam, gases, and water had passed in their ascent. Whether the action took place under or above the sea would be determined by the presence or absence of the ordinary marks of oceanic denudation.

When clays strongly ferruginous, and soft from saturation with water, are dried, the iron previously held in solution by the water is deposited between the particles and cements them into a hard compact rock. Hence the induration of laterite clays on exposure to the atmosphere.

nature, at one time producing a superficial effect, either uniform in its character, or small in degree, and at another time increasing in violence, and at particular points causing convulsive elevations of the rocks in the form of hills, frequently in undulating ridges and chains, the linear directions of which were, it may be, determined by a pre-imposed tendency to fracture, as will be noticed in the sequel. This force was apparently of a volcanic, or what, to distinguish it from concentrated well developed volcanic action, may be called a semi-volcanic nature, producing great heat at particular places, which sometimes merely indurated or calcined the softer strata and reddened the superjacent soil, but often in steam or gases, and occasionally in mud or semi-fused rock burst through them, or found a vent in fissures caused by ruptures during the process of elevation. When the heat was most intense, fused rocks or semi-fused fragments were cast up through these vents. As its intensity decreased fragments less altered and masses of clay and sand were ejected. The volcanic steam, gases, or fluids were charged with iron which left strong marks of its presence wherever these were most active, rendering most of the fused and semi-fused rocks, in dykes or ejected above the surface, highly ferruginous and impregnating all the softer adjacent rocks.

In some places the force, although of unusual violence, was at the surface chiefly mechanical, rending solid sandstones and tossing up and mingling the fragments with masses of soft clays and shales. Thus on some parts of government hill and the adjoining hill (Mt. Sophia) large angular blocks of solid sandstone, some from 600 to 800 cubic feet in bulk, are found at the surface and at various depths beneath it in a confused mass of clays and shales. In the same hills however there were also subsequently formed volcanic fissures, through which torrified rocks were ejected into the air and strewed over the surface so as in some places to form a thick bed over the disrupted sandstone, &c.

This extreme degree of local mechanical violence unaccompanied by simultaneous igneous action reaching the surface, is, however, rare, and may have been in some measure caused by a greater thickness and compactness in the resisting rock. But in general the upheaving of the hills has been attended with a violent agitation or tremor, producing the phenomena alluded to in a former page as due to concussion.

From what has been said it will be seen that the volcanic forces were

not concentrated at one or two points, and of comparatively great power, so as to form regular craters of eruption or to elevate rocks to a great height, but that they extended over a considerable area, and that their intensity and mode of action varied greatly at different places.

Amongst the most common volcanic products is one, small in size, and varying in its character from common indurated argillaceous and lithomargic, to porcellanous and jaspidious, which occurs in very singular forms, vermicular, pseudo corraloidal, columnar,* and frequently resembling pieces of ginger root, externally smooth, granulated, corrugated, reticularly fibrous, &c. These are the compact forms, but there often occur vesicular, or rather rudely ramose cavities descending between the short thick irregular branches towards the centre, the branches being themselves also sometimes perforated.

Another product is a small smooth faintly shining black stone like a fine gravel.

At other places a gravel similar in shape but with a brownish or chestnut-coloured coat or enamel occurs. These latter products may readily be mistaken for water worn gravel, especially as they often occur in broad thin beds, but on closer examination it is clear they are of volcanic origin.

All the various forms of ejected substances met with are due, I conceive, in some degree to differences in the original mineral ingredients of the rocks, but chiefly to the inequality of torrefaction, and the circumstance of the heated, fused or semi-fused substances cooling in the air or in mud or loose sand or clay.

At an early stage in my inquiries I was led to think that the causes of the eruptions were in part what have been called pseudo-volcanic, and if coal shall be discovered it will then become a question whether many of the geological phenomena of Singapore are not due to volcanic action giving rise to and accompanying the conflagration of coal beds. This would account for the paucity of proper volcanic products at the surface, and the abundance of merely altered fragments agreeing in

* Amongst the common large slags which are generally of irregular rounded shapes, I have occasionally seen one agreeing in form with those small columnar stones and externally rugose and roughly fibrous. In fact one may say it is the same as one magnified in bulk from a few cubic inches to 10 or 15 cubic feet, and with all its characters rendered coarse in proportion.

character with the existing superficial strata, and of slaggy and scoreous rocks of which the materials, with the exception of the oxides of iron, might have been derived from similar strata at no great depth. The iron might, on this supposition, have been supplied by beds of ore occurring amongst the carboniferous rocks.

At present this view is inadmissable; and it would still remain so even if no other hypothesis derived from analogy were probable. But there have been many volcanoes without streams of lava, from which earth and altered rocks, gases, steam, water, or mud have been ejected, and there are abundant marks of igneous action throughout the series of stratified rocks, proving how frequently volcanic forces have operated from beneath, often without reaching the surface at all, and at other times producing mechanical, igneons, or electrical changes in the superficial rocks, unaccompanied by the more marked phenomena of proper volcanoes.

But the absence of such products in Singapore is not universal, nor are there wanting proofs of the direct connection of the superficial igneous action with a great nether fountain of volcanic power. It is clear that the action reached below the stratified rocks, for in some of the hills near town I have discovered fragments of unaltered sienite, and on one, a large block of sienite passing into basalt, which may either be an ejected fragment, or the protruded summit of a continuous mass, is now being quarried by Chinese. In the Bukit Temah group solid masses of sienite are exposed, and appear to compose a large part of one of the hills. At some places I found it passing into basalt. That the *elevation* of the sienite and basalt was contemporaneous with the production of the ordinary volcanic or igneous phenomena of Singapore (if the basalt itself was not also then formed) is, to say the least, highly probable. Not only the sides in general, but the summits of the hill, consist of a thick mass of soft ferruginous clay or mould, holding large quantities of the common igneous rocks found elsewhere, but often bearing marks of a more intense igneous action. Thus on the same side of the hill where the sienite and basalt are laid bare I found, in contact with soft sandstone, a piece of compact, dull, igneous rock of a light yellowish brown colour, with veins of a violet colour and vesicles whose sides were similar. At the plane of contact, the rock changed into a dark green translucent-glass, which included some

small opaque white specks. Within the glass, the igneous rock, for a narrow space, was finely vesicular, and violet-coloured like veins and some grains of the sandstone were scattered through this band. The opaque spots in the glass were evidently included grains of sand semi-fused at their edges. This specimen is identical in character with some products of proper volcanoes. In the slopes to the west of Bukit Temah, which are covered with thick beds of clays and sands, included layers, composed of fragments of torrified granite, occur.

Many of the islands and rocks near Singapore exhibit most decisive proofs of volcanic convulsions. Thus in a reef of sandstone rocks lying between the Island of *Blakan Mati* and *Pulo Sikijang*, a black ferruginous rock has been obtruded as a lava through seams and fissures in the sandstone, and at some places has spread over that rock and boiled up above it, assuming fantastic shapes, the sandstone is altered by heat in the same manner as the rock is often seen to be in Singapore.* Basalt and greenstone are found on Pulo Ooban, which lies close to the north-east coast of Singapore. Similar rocks of various structure and character, compact, vesicular, &c. with claystone, porphyries and other volcanic minerals, are brought from Islands in the neighbourhood to Singapore to be used for the foundations of houses. The original production of the latter rocks must of course be referred to an epoch long anterior to that of the former, which undoubtedly corresponds with that of the Singapore semi-volcanic rocks.

We are therefore, I think, justified in considering Singapore and the neighbouring Islands to have been the seat of volcanic convulsions spread over a considerable area, if nowhere of great intensity. There are many reasons, but not strictly local, to believe that their date was in a late era of geological time. The subject however is a difficult one, and there is not room for its full discussion in this paper. I may here only mention amongst the local facts tending to the above conclusion, the softness of some of the rocks which have not been altered by volcanic action, but have been elevated and greatly stretched or drawn out, contorted or compressed in the process; the absence of any superficial changes not due to atmospherical causes since the time of their eleva-

* Mr. Thomson describes to me an analogous injection of a reddish-black substance, lateritic in its appearance, into the fissures of a block of *granite* on the north coast of Buntang. This I shall describe on procuring a specimen, if I do not visit the locality.

tion, and the very moderate effects of these causes ; the apparent continuity of some of the hill beds of sand and clay in adjacent hollows, having a ferruginous and torrified appearance in the former, while in the latter they are not distinguishable from soft modern alluvium ; and lastly, some remarkable cases of the elevation of soft alluvial and vegetable deposits agreeing in their character with beds now forming in the Island or along its shores.* Unfortunately the non-observation hitherto of any organic remains, while it is perhaps a reason for assigning a higher antiquity to the soft rocks above mentioned than their general appearance seems to claim, renders it very difficult to compare them with the observations of European Geologists, or to ascertain whether they can be made to occupy any determinate place in their systems. This last enquiry is however of the least importance for the present, and if entered upon before the phenomena of this locality, (so far removed from any of which the geology is, in any considerable measure, understood,) have been minutely and faithfully studied by themselves, is more likely to mislead than to aid research. I may state however that, in the present state of our knowledge, the only European system with which the rocks of Singapore, notwithstanding the apparently recent origin of some of them, can he *mineralogically* compared, is the New Red standstone. The sandstones, clays, marls, (noncalcareous) and shales, in many respects resemble the same rocks of that system. The rareness, if not the absence, of fossils, is a striking circumstance, and even if the two formations be remote in time from each other (for no chronological conclusion can be drawn from merely lithological characters), points to the existence of anologous conditions during the periods of their respective accumulation.

If we now recur to the present superficial igneous and ferruginous deposits of Singapore, the only remaining question under our hypothesis would be, whether their superposition on the hills (to which they are confined) took place before or after the emergence of the latter from the sea. In other words, was the present configuration of the Island

* It is to be remarked however, that in a climate like that of Singapore, clay rocks and aluminous sandstones at or near the surface, unless highly indurated, are liable to become soft. The age of the elevation of the Island will be more fully considered in the paper on the straits, in connection with several instances of recent elevation occurring along its borders where the evidence is of a more satisfactory nature, being derived from organic remains.

assumed under the level of the sea, and then the whole tract of land from which the hills spring, elevated by one movement, or is it more probable that before the hills were upraised the general level of the land was the same or nearly the same as it now is, and the hills consequently obtruded from that level in whole or in part in the air? The action of the waters of the sea in spreading out the materials brought to the surface by volcanic forces might seem an obvious explanation of some of the facts formerly noticed. But if this cause be admitted at all, its operation must have been transient and limited, otherwise the surface accumulations on the different hills and parts of the same hill would not have retained their striking local characters.* If the agency of the sea is to be admitted, the most probable hypothesis, with our present information, would be, that when the process, which dislocated and pushed up the strata in different places into hills, began to operate, the general level of the sea bed was much lower than it now is, and that the same action caused its general elevation. In this way the surfaces of the hills may have emerged so gradually from beneath the sea as to admit of a partial action of its waters on their summits and sides during and subsequent to the eruptions of matter, and yet not so slowly as to give time for such extensive denudation as to obliterate the local peculiarities of the ejected substances. My own opinion at present is, that all the phenomena may be accounted for by purely volcanic, succeeded by ordinary meteoric causes. At one time rock fragments and semi-fused matter would be voided, heaped up at particular places, or ejected into the air and showered over the surface. At another time, when the heat was less intense or when steam or gases, not ignifluous or melted matter, burst out, masses of soft clays and sandstone might be disembowelled and spread over the bed of fragments. At other places the rocks might be broken and pulverized *in situ*, and receive a considerable vertical pulsion so as transiently to form an incoherent and agitated mass, especially towards the surface, but without the fragments or sand being freely projected into the air.†

* See ante page 527, *Diluvial hypothesis.*

† Whether the mechanical action by which the hills were upraised long preceded, or was accompanied or soon followed by, semi-volcanic action in the most intense degree which it here attained, or rather whether the semi-volcanic emissions and eruptions continued during a long period to find vent through the fissures formed when the hills were elevated, is a question that must lie over for the present. It is probable that they

One of the most common features of the hills is the occurrence of a bed of igneous stones,—at one place large (30 to 60 cubic feet) slaggy and often scoreous or amygdaloidal, and gradually but irregularly diminishing in size until they become a coarse and then a fine gravel, in some places dwindling into a seam of minute grains. The beds are of various thickness,—from three or more feet to a few lines,—and so, often, is the same bed at different places. They may consist of a uniform aggregate of stones, or of stones mingled with loose clay, sand, &c. Over this deposit there is generally a bed of soft clay, or sandy clay. Sometimes more than one bed of gravel occurs. Layers of unaltered angular fragments are occasionally, but rarely, found beneath these beds. Layers of the small porcellanous, jaspideous, and varnished stones before noticed, and of large grains of quartz, are more common. All these layers sometimes appear in the same section, but this seldom happens. The localities where the large scoriform rocks abound are often at or near the summits of hills, or where thick dykes of igneous rock come to the surface, and probably in every case they mark the places where the largest fissures or vents were opened. Where they are most abundant they appear at the surface, and that not only in spots exposed to denudating influences, but in flattish and gently sloping tracts. There appears in many cases to be a connection between the direction of the dykes and fissures, and that of the hills or their spurs. Where good sections of the summits of dykes have been obtained fragments of the rock of which they are composed, not angular but scoriform, can generally be traced as a horizontal layer on the surface, or disposed beneath a bed of clay, &c. to a considerable distance from the head of the dyke. When the dyke is vertical these stones are accumulated over and strewed on both sides of it. When it is inclined they are spread out in the direction towards which the inclination is. Two dykes adjoining each other at the surface have sometimes beds of scoriæ diverging from them in opposite directions, owing to their dips being opposed. The above and other observable facts are all, I think, explicable by the species of volcanic action which I have suggested, susceptible as it is, of various modifications, without resorting to oceanic agency. At all events no fact has yet come under my notice unequi-

originated on, but lasted, or were from time to time repeated, for sometime after the elevation of the hills.

vocally attesting the abrading, sorting, or transporting operation of a large body of water, or which could not be referred to some known form of volcanic agency. It must also be borne in mind that the convulsive mechanical action which enters so largely into the general hypothesis, would be most powerful in shattering compact and loosening soft rocks, when the stratified masses were ruptured and raised into highly inclined, vertical or reversed positions. In such cases the exposed basset edges, in their fragmentary or pulverized state, and before they were protected by any vegetation, would be more acted on by meteoric causes than at present.

The system of hills with their dykes and veins affords an interesting field for the application of the principles of mechanical science. But it would be premature to enter on this subject before the country is better opened up, as it will soon be by the lines of road now in progress. There can be little doubt however that the directions of the hills agree with the ramifications of fissures which in those places where the intensity of the elevatory force caused their extension to the surface, have formed vents through which the superficial volcanic deposits were expelled. The principal ranges, we have seen, are nearly parallel and have directions approximating to N. W. and S. E. The lateral hills are placed on lines at right angles to these, and the secondary lateral hills again on lines parallel to the principal ranges.

My remarks have been hitherto confined to facts entirely local, and inferences or hypothesis strictly deduced from, or applicable to them. Before concluding this paper, however, let us extend the limits of our observations, and see whether a wider geological area presents phenomena repugnant to the large influence which has been assigned to volcanic causes.

That the movements which elevated the central mountains of the Malayan Peninsula had an intimate relation with those that elevated the mountains of Sumatra, seems evident, whether we regard the hypothesis of De Beaumont, the more recent observations and theories of Mr. Darwin, or the mechanical researches of Mr. Hopkins. Both form long chains which pursue parallel lines not more than 3 or 4 degrees distant. But we must probably take in a much wider geographical range if we would seek a general geological theory for the region which they traverse. The mountain chains of the Peninsula of India

are parallel, or approximately so, to the Malayan, and like them, spring from the great central system of Asia. The chain of the Peninsula of Malaya is directly continued to this region, and from it descend nearly parallel chains through Burmah, Siam and Cochin China. These ranges determine the general direction of the sea coasts wherever these are exposed to waves sufficiently strong to prevent the formation and extension of alluvial plains. The western coasts of India and of the Tenasserim Provinces, Siam, the gulf of Siam and the eastern coast of Cochin China are thus fixed. A wide and interesting field of inquiry is opened up by the probable geological connection between the regions of these ranges and those of the Indian Archipelago generally, Australia and the Archipelagoes of the Pacific, evidenced by the prevalence of parellel lines of elevation, and perhaps also by organic remains, such as the fossil elephant and some of the carboniferous plants of New South Wales. The former existence of a great Australasian continent, an extension probably of the present continent of Asia, which seems to result from Mr. Darwin's theory of Atolls, would be an inference in accordance with these facts. Viewing the whole region, interspersed with peninsulas and islands, from the Indian Ocean to the heart of the Pacific, as one, it appears that De Beaumont's theory of parallel rectilinear or oblong areas of elevation and subsidence, which Mr. Darwin has applied to the eastern tracts, requires modification, and that if we conceive curvilinear lines or systems of parallel curvilinear lines proceeding from centres and often meeting similar lines or systems from other centres, and again lateral and secondary lines diverging from the principal, the arrangement of the observed ranges will assume greater symmetry, and be found perhaps to accord with the hypothesis that *one* widely extended mechanical pulsion, accompanied by local foci of intense development from weakness in the rocks or increased plutonic or volcanic action, gave the first direction to all the main lines of elevation. Thus let us conceive such a centre to be situated in the western half of New Guinea, and we have some independent warrant for doing so, in the circumstance that the mountains of its unexplored interior appear to attain a magnitude unusual in the Archipelago. From this focus we may trace one great curvilinear fracture or band of rupture of the earth's crust through the Sunda Islands to Chittagong ; a second through the mountainous volcanic islands of Ceram and Bouro, and

along the southern coasts of Celebes and Borneo (Gaonong Ratos), Billiton, Banda, the Malay Peninsula, &c.; a third through the Phillipines, Formosa, Japan, &c.; a fourth along the southern coast of New Guinea, and through the Solomon Islands, New Hebrides, New Zealand, &c.; a fifth along the southern coast of New Guinea, across Torres Straits and along the eastern coast of Australia, and a sixth perhaps through the north-western division of Australia. Other principal lines probably proceed across the Moluccas and Celebes, through Borneo and the islands of the China sea (now a subsiding tract), and join the mountain chains of Cochin China and Siam, but the geography of Borneo is not sufficiently known to allow of our positively ranking these as seventh and eighth lines. The intermediate areas may be occupied by numerous other lines, but the subsidence of various tracts renders it difficult or impossible, particularly to the eastward, to trace the original courses of vertical movement until the soundings of the Polynesian seas are ascertained. Subsequent shifting subterranean action would cause many other fractures in various directions, but it would not, at least until the lapse of a long geological epoch, obliterate the primary lines. It would often cause cross fractures, of which many instances might be pointed out. It is no objection to this hypothesis that many of the lines seem to proceed from the central table-land of Asia. Because if at the time these fissures were being extended southward, a great local action took place at or near New Guinea, they would, according to the mechanical laws examined by Mr. Hopkins, diverge from their original direction towards that point, or to meet the lines radiating from it. Thus we observe the two least broken lines to pursue a southerly direction till they reach the parallel of 8° N L., when, at the Nicobars in the one and at Junk-ceylon in the other, they are deflected to the S. E. When they cross the meridian of 106° E. they make a more decided bend to the eastward. If we follow these lines and the chains of Siam and Cochin China northward we may trace them upwards to the Bayan Khara mountains, and thence to the vast central mass of Kulkun, from whence great ranges are said to proceed towards all the points of the compass. But in the north-western part of the province of Yunnan and north-east of Burmah and Assam their continuity is interrupted, and we seem to have ascertained another central region whence radiate not only the lines which afterwards converge to New Guinea,

but various other curvilinear ranges proceeding S. E., E., N. E., and N. through China, and N. and N. W. through Thibet, and lastly, the Himalayas and a minor range proceeding south-eastward on the south of the valley of Assam, and continued perhaps in the Vindyas,—for a subsequent line of subsidence passing down the plain of the Ganges and through the Bay of Bengal, of which there is some evidence, may have destroyed the pre-existing continuity. Many of these ranges proceed primarily from the Kulkun, but it is remarkable that they converge towards the region indicated. The region where the Himalayas attain their sublimest proportions and give birth to rivers that embrace them and all India in their courses, is another grand focus. From this centre the range proceeds on the one side to the eastward, and on the other to the N. W. To the north of the former a secondary and approximately parallel range also proceeds eastward, and includes with it the valley of the Sanpao, and to the south another and smaller secondary parallel range traverses upper India. To determine the original centres of maximum intensity and directions of the forces that elevated the great connected mountain system that forms the skeleton of the Asiatic continent, is a problem beyond the present reach of geology.*

The Malayan chain I have mentioned as a series of groups, and from the breadth of country which their members occupy compared with their height and apparent bulk, and their general appearance as viewed from the Straits, I am led to believe that they consist of connected systems, each analogous to that of the Singapore hills, or of principal undulating masses from which parallel ranges proceed in a N. W. and S. E. direction. The rivers probably have their sources at the heads of the valleys included between these ranges and turn seaward at the

* There can be little doubt that an extensive knowledge of the physical and mineralogical constitution of mountain ranges will form the true basis of the highest department of the science, now only dawning,—the Mechanism of the Earth. But the day is probably not far distant when the geologist, like the astronomer, will need to be thoroughly indoctrinated with the principles of mechanical science in its widest sense. Fortunately for the worshippers of nature of humbler acquirements, geology is so immersed in matter, so wrought into every inch of the earth, that its Priests have need of a whole tribe of Levites. Wherever a man finds himself placed he has but to employ his eyes to become a useful labourer, and so far will a little knowledge be from proving dangerous to him that it may be safely said, that while even entire ignorance is not a bar to the collection of facts, every little accession of knowledge from any of the sciences becomes an instrument of observation.

extremities of the ranges. The most southern rivers, such as the Johore, Sakadai, &c. which flow southward, would also bend to the east and west, where the last system of the continent terminates and that of Singapore begins, did they not meet with a depression so low as to be accessible by the sea.

Singapore is merely separated from the mainland by this depression, which forms a narrow tortuous river-like arm of the sea, and is in fact sunk into the continent and embraced by it on three sides, so that its southern shore seems to be the proper continuation of the southern coast of the Peninsula. Its geographical connection with it is therefore complete. When we cross the strait no difference in the topography is observable. And the low hills which give the surface an undulating appearance like that of Singapore, probably resemble those of the latter in their internal structure as much as they do in the superjacent soils and in the stunted jungle. The interior of the Peninsula is almost wholly unexplored. In coasting along its western shore from Pinang to Cape Rachado a high chain or rather series of ranges of mountains is observed inland nearly the whole way, which from their generally sharp-peaked summits, the nature of the detritus brought down from them by the rivers, and the evidence afforded by the few points where they have been reached, we are justified in believing to consist in great measure of plutonic rocks. In front of this range we observe a broad tract of country often appearing to be perfectly flat and very little above the sea level for miles together, but from which sometimes low hills rise like Islands out of the sea. These hills are frequently quite solitary and at a great distance from the central mountains, or near the coast. Further inland they seem to be generally in groups, and towards the mountains the country at some places appears hilly and undulating. At Malacca these low hills are so much grouped as to resemble some parts of Singapore, and they are covered by gravel and fragments precisely similar to those found on some of the Singapore hills. In some of the hills opposite Pinang I observed similar fragments. In both cases the soil had a deep red ferruginous aspect.* That most of the hills scattered along the western plains of the Peninsula were Islands in the sea at no remote date, there can be no doubt. The plains from

* Cape Rachado is described by Crawford to consist of quartz rocks interspersed with frequent veins of clay iron ore.

which they spring are flat, generally only a few feet above the sea level, alluvial and at some places abounding in marine shells of the same species that at present inhabit the straits. The rivers of the Peninsula, although generally small, are exceedingly numerous, and bring down large quantities of sediment. In March last, off the mouth of the Salangore river, the steamer in which I was, passed through a broad tract discoloured by the sediment. Extensive mud banks have been formed in the straits and are constantly increasing. For evidence on this subject I must refer to a separate paper containing some remarks on the Straits of Malacca and the alluvial tracts along its sides. It is not therefore unreasonable to conclude that the whole chain of these hills from Pinang to Singapore has a strict geological connection. At Malacca hot springs exist, and the hills nearest to them are of the nature before mentioned. We naturally resort to the mountain chain of the interior for the seat of that central volcanic force of which the manifestations on these outskirts are of so peculiar a character, so wide in their extent yet so devoid of intensity. But we find that there is no evidence whatever of any volcanoes ever having existed in this chain. If there ever were any their fires have long been quenched.

If we now direct our attention to the southward of Singapore, we find that it is but one of an extensive archipelago of Islands, stretching to the south-east, and which after a slight interruption, is continued in Banca. That the geological chain continues to the latter Island is clear from the account which Dr. Horsfield gives of it. According to him the elevated parts of Banca consist principally of granite, but in the secondary elevations "*red iron stone*" is extensively distributed in single rocks, or in veins of many united together covering large tracts of country.* This circumstance and the general topography of the Island, as described by Dr. Horsfield, assimilate to Singapore. The paucity of tin ore in the latter arises from the want of granitic hills. Bukit Temah, the only hill yet explored in which sienite abounds, contains tin,

* See memoirs of Sir S. Raffles, p. 150. Major Court, in his account of Banca notices the gravelly nature of the soil (Court's Palembang). Professor Jameson, in Murray's Encyclopædia of Geography, mentions the circumstance of the primitive mountains being immediately bounded by a formation of red iron stone doubtingly, and adds, "Crawford who makes this statement gives no description of the formation." From Crawford's meagre notice of Banca I presume he does not write from personal observation, and like Sir S. Raffles, he probably derived his information from Dr. Horsefield's manuscript.

and in fact derives its name from the circumstance, as it literally signifies "Tin Hill." We thus find that what we may call the semi-volcanic band of the straits of Malacca may, to a certain extent, be disconnected from the Peninsula, and viewed as a chain of Islands extending probably from Junk-ceylon to Banca, and inclnding the existing Islands and numerous rocks and reefs in the straits of Malacca. It appears therefore, that its southern extremity is almost in contact with Sumatra,* and the question arises whether its volcanic connection be not with this great Island rather than the Peninsula. May it not be reasonably presumed that if the origin and partial elevation of the Sumatra chain was contemporaneous with that of the Peninsula, the line of greatest intensity of the subterranean forces, in whichever it was originally, was ultimately determined to the latter chain, and that at some now ancient era the former was left to comparative repose? The height of the plutonic mountains of the Peninsula is greatly inferior to that of the mountains of Sumatra. But all the elevated peaks of the latter appear to be volcanic, and perhaps the purely granitic ranges are not more elevated than those of the Peninsula. The elevation of the two plutonic ranges and the shallow bed of the strait between them may have been contemporaneous and antecedent to the period when volcanoes burst out along the Sumatra chain. These volcanoes, from their number and power would arrest the rise of the region, or cause any subsequent elevatory movement to be rare and of small amount. Until the interior of the Peninsula is explored these inquiries to a large extent must be merely speculative. But it is certain that the Sumatra chain has in recent eras been the seat of great volcanic energy, and that it is still subject to convulsive movements, the tremors or undulations of which are transmitted as far as what I have termed the semi-volcanic band of the straits on the one side, and which are felt much more severely in the less distant chain of Islands on the west coast of Sumatra.

Marsden states that a number of volcanoes exist† and describes one which opened in the side of a mountain about 20 miles inland of Bencoolen, and which during his residence at that Factory scarcely ever failed to emit smoke. To the S. E. the three volcanic peaks of Gunong

* It will appear however in the paper formerly referred to that this approximation is due to modern external, not to ancient internal forces.

† History of Sumatra, p. 24.

Dempo, Lumut and Berapi, rise to the height of 12,000 feet. Gunong Dempo was ascended by Mr. Church, the present resident councillor at Singapore, with the late Mr. Presgrave in 1818. An interesting account of the ascent is inserted in Raffles' Memoirs, (p. 323.) Mr. Presgrave states that he had frequently seen smoke issuing from the mountain, and the natives informed him that within their memory it had emitted flames attended with a loud noise. In the upper region of the mountain the party found the trees dead and externally burned quite black. Further north is the great central volcanic region, partially at least included in the ancient kingdom of Menang Kabu. This is described by Raffles, (Memoirs, p. 347) as being exclusively volcanic. The rocks are mostly basaltic. Two lofty volcanic mountains rise near the large lake of Sincara. From one of these, Gunong Berapi (fiery mountain) which is above 13,000 feet high, smoke issued. Hot springs also exist here. To the east of the lake at the rocks consisted of felspar, granite, quartz, &c. mixed with a great variety of volcanic productions in the greatest confusion. Iron ore of various kinds lay in the path of the travellers. To the west of the lake were found granite, marble, great varieties of limstones, masses of calcareous spar and many other substances. On the N. E. of the lake near Pageruyang numerous stumps and trunks of trees in a state of petrifaction protruded from the ground. The limits of the region on the north and south are not ascertained. About 60 miles south of Mt. Talong another Gunong Berapi occurs. Near Mt. Ophir a volcanic mountain is marked in Marsden's map, and Mt. Ophir itself is probably an extinct volcano. Further north still lies another of the ascertained volcanoes Mt. Batagapit. Mr. J. Anderson, who visited the east coast in 1823, mentions* a native tradition of an engagement having taken place between two of the mountains in the interior of Delli (Sebaya and Senaban) when part of them fell into the valley. From these mountains sulphur is procured, which if it does not prove that they are formed of volcanic materials as Mr. Anderson conceives, at least leads to the inference that they have been the seat of volcanic action. At Acheen abundant supplies of sulphur for internal consumption and exportation are obtained from a volcanic mountain in the neighbourhood.† Lastly, one of the western chain of Islands, Si Beero, according

* Mission to the E. coast of Sumatra, p. 199. † Marsden, p. 313.

to Marsden, possesses a volcano. Earthquakes are of frequent occurrence. Marsden notices one of unusual severity, which occurred in 1770.*

Sir T. Raffles mentions that on the east coast they are said to happen every 5 or 6 years.† The Malays on the east coast represented to Mr. Anderson that slight shocks were occasionally felt‡ and the same information was received by Lieut. Craoke at Jambi.§ In the interesting memoir on this state by that officer appended to Mr. Anderson's work, it is likewise mentioned that a violent earthquake was stated to have been experienced about 20 years or more previous to his visit in 1820, and to have been preceded by a period of great heat and drought, which ruined the crops and occasioned a distressing scarcity of food. It is not improbable that this earthquake was simultaneous with one which happened in 1797, of which the effects on the opposite coast is mentioned by Raffles. "It is stated that the vibratory shocks continued for 3 minutes, and recurred at intervals during the space of 3 hours till the shock completely ceased. At Padang, the houses of the inhabitants were almost entirely destroyed and the public works much damaged. A vessel lying at anchor was thrown by the sudden rise of the tide upwards of three miles on shore. The number of lives lost there amounted to above 300 : of these some were crushed under the ruins of falling houses, some were literally entombed by the

* "The most severe that I have known, was chiefly experienced in the district of Manna, in the year 1770. A village was destroyed by the houses falling down and taking fire, and several lives were lost. The ground was in one place rent a quarter of a mile, the width of two fathoms, and depth of four or five. A bituminous matter is described to have swelled over the sides of the cavity, and the earth, for a long time after the shocks, was observed to contract and dilate alternately. Many parts of the hills far inland could be distinguished to have given way, and a consequence of this was, that during three weeks, Manna river was so much impregnated with particles of clay, that the natives could not bathe in it. At this time was formed, near to the mouth of Padang Goochie, a neighbouring river, south of the former, a large plain, seven miles long and half a mile broad; where there had been before only a narrow beach. The quantity of earth brought down on this occasion was so considerable, that the hill upon which the English resident's house stands, appears, from indubitable marks, less elevated by fifteen feet than it was before the event." *Id.* p. 25.

† Memoirs, p. 295.

‡ Anderson, *ut supra*, p. 199.

§ *Id.* p. 402.

earth opening on them, and others were drowned by the sudden irruption of the waters of the ocean."

On the 18th April, 1818, another violent earthquake was experienced on the west coast. Sir T. Raffles, who arrived at Bencoolen the day after, found that every house was more or less shattered, and many in ruins. In the Island of Pulo Nias, on the west coast, earthquakes appear to be felt very severely. The same remark may possibly apply to the other Islands in the same chain, for our knowledge of these phenomena in the native countries has been hitherto almost entirely accidental, and our information regarding Pulo Nias arises from the connection of Europeans with it. Marsden mentions that in 1763 a village in that Island was swallowed up by an earthquake, and a recent shock, which will be immediately noticed more at large, was still more disastrous in its effects. That the undulations in most cases extend across the straits to the semi-volcanic line is highly probable. Although our connection with the straits now extends over a period of 60 years, unfortunately no connected records have been preserved of the critical geological and meteorological phenomena that have been experienced during that time. In Pinang during the last 12 years several shocks have been felt. These occurred in November 1833, August 1835, September 1837 and January 1843.*

Those of 1837 were the most violent, and the undulations appear to have been from south to north, and to have lasted a minute and a half.† The shocks in 1843 happened about half an hour after midnight on the morning of the 6th of January, and at ½ past 2 P. M. on the 8th. The

* Pinang Gazette of 7th, 14th and 28th January, 1843.

† "It is said that on that occasion several herds of cattle in the neighbourhood were observed running in the utmost confusion in all directions, that lamps and picture frames oscillated, that the Roman Catholic Church bell rang of its own accord, that quantities of large shot piled up in the Fort were thrown down and scattered about, that a stone wall of a substantial building in town was rent, and that the whole inhabitants were thrown into a state of consternation. The shipping in the harbour did not experience this shock, nor did the sea appear agitated. Five days subsequently, however, another smart shock was felt and was followed by a very heavy squall from the N. W. and great agitation and rise of the sea in the harbour. The tides overflowed the Northern beach, and flooded the compounds and lower rooms of the houses in the neighbourhood. This convulsion was experienced about the same time at Acheen and along the Pedier coast, and it is said that these places sustained considerable damage." Pinang Gazette of 28th January, 1843,

first shock was more severe than the second, but both were slight, producing no other mechanical effects than a tremour of the ground which caused articles suspended to oscillate, stopped a clock, and occasioned in some persons a giddiness in the head. The first shock although only felt by a few persons in the plain, who happened to be awake, caused the residents on one of the hills to spring from their beds under the apprehension that robbers had attacked their houses, so violent was the noise of rattling venetians, bolts, &c. The undulations on this occasion, as in 1837, appeared to be from south to north. The shock on the morning of the 6th was experienced precisely at the same instant at Singapore* and at Malacca.† The undulations at Singapore are said to have been from east to west, very slight, and to have lasted 8 or 10 seconds. About half a year afterwards it was first learned in the Straits that a most violent earthquake had devastated Pulo Nias, commencing about midnight, between the 5th and 6th January, or nearly the same time when the undulations were felt along the western coast of the Peninsula. The shocks were at first from the west, shifting to the north, but as they increased in violence they appeared to lose any fixed direction and became a complete trembling of the earth, which lasted 9 minutes; houses were destroyed, trees uprooted, a portion of a mountain fell, and the ground opened in wide fissures, from which "a black frothy liquid trickled." After a brief interval of inaction, the undulations recommenced and the sea suddenly rose in a vast wave which rolled in from the south-east, overwhelming a considerable tract of country and sweeping away whole villages and their inhabitants. The shocks were felt at intervals of 2 minutes until ½ past 4 in the morning, when another paroxysm even more violent than the first took place, lasting about 6 minutes. The shocks were from the west, veering to the north, but changing directly to the south. Tremours of the ground were experienced for several subsequent days. Thus the latest earthquake that has occurred in this region was experienced in its greatest violence a little to the west of the volcanic chain of Sumatra, and the undulations were transmitted or induced so widely and so rapidly as to reach Penang, Malacca and Singapore simultaneously and at or about the same time when the first shock was felt at Pulo Nias.

It appears therefore that the volcanoes of Sumatra still communicate

* Singapore Free Press of the 12th January, 1843. † Id. of 2nd February, 1843.

with an internal igneous sea, and from time to time emit smoke and gases, that to this day the Island is subject to frequent earthquakes, that several of those that have occurred within the last hundred years have been of great force, rending the ground, and at least on two occasions giving vent to liquid volcanic matter, and that their operation extends, though with diminished violence, to the western coast of the Peninsula. When we consider the height and bulk of the crateriform volcanic mountains even viewed only relatively to the level of the hilly country above which they rise, and the large belts of volcanic rocks which exist in the neighbourhood of some of those that have been explored, if they do not connect the whole chain, we are carried back to a period in the history of Sumatra during which its volcanic phenomena were on the grandest scale. If at this day, when the fires of her mountains have ceased, or are dormant, the coast of the Peninsula is agitated by the comparatively feeble shocks which disturb the repose of the Island, it is reasonable to believe that when her volcanoes, whether simultaneously, successively, or alternately, were in full activity along a line of nearly a thousand miles, the neighbouring regions to the distance of 100 to 200 miles must have been subject to earthquakes of great violence, and accompanied, according to the degree of their intensity, by volcanic emissions and eruptions in greater or less abundance. That portion of the volcanic belt where the evidences of violent igneous action are most striking, appears to be Singapore, and the neighbourhood, although it is not improbable that the whole tract from Cape Rachado to Banca, exhibits more extensive and continuous disturbance than the northern part of the belt. That region of Sumatra which, so far as observation has extended, may be termed the principal volcanic tract, is about 3 degrees distant from Singapore, and lies in a parallel about a degree and a quarter to the south of this Island. The direction of the Singapore strata is across or approximately at right angles to parallel lines forming the sides of a plane connecting the Island with this part of Menangkabu, and the dip of the strata although, as formerly observed, exhibiting much irregularity, is generally from the point of the compass where Menangkabu lies.

There seems, upon the whole, to be strong grounds for the opinion that the hill system of Singapore has its volcanic* connection with

* Our meagre information regarding the formations of Sumatra does not admit of our instituting a comparison between them and the rocks of the opposite coast of the Penin-

Sumatra and not with the mountain chain of the Peninsula. If this view shall be found to be borne out by further observations, we must conceive that the old granite mountain chain of the Peninsula (which, as is shown in the paper before mentioned, terminates apparently between Parcelar Point and Pulo Varela, although a few minor groups exist in the interior to the southward) had its extremity in this direction washed by the sea. The region below which operated the expansive volcanic fluids or gases whose effects we are considering, extended from Sumatra to the Peninsula, and probably a little to the westward of the one and considerably to the eastward of the other, for the whole vast platform or partially emerging and partially subsiding continent that rises out of the depths of the Indian ocean and stretches eastward far into the Pacific, rests on one region of connected though shifting subterranean excitement. The line of most intense force would be the ordinary one, the volcanic chain of Sumatra. Thence the waves of the volcanic sea would travel in parallel lines to the north-eastward, causing a tension of the region and a tendency to split in the direction of those lines. That portion of the region intermediate between the western and eastern mountain chains which had not been disturbed and fractured during the process of elevation like that from which the chains were obtruded, or of which the fractures had not reached the surface, would offer most resistence. But on arriving at the western limit of the old fractures caused during the elevation of the Malayan chain, the space so fractured would yield in various points of weakness. The old fractures at the southern extremity of the chain would, by the tension, be prolonged in the same direction, that is to the S. E., and cross fractures being established and the vol-

sula. The central mountains are chiefly plutonic and volcanic. The granite or sienite of the southern regions would appear from Marsden's slight notice to resemble that of Singapore. The lower tracts of the west coast as described by him possess a remarkable resemblance in their general configuration to the surface of Singapore. Like the latter, they consist of rounded elevations of no great height, separated by winding flat swamps penetrating for miles between them. The hills "not unfrequently exhibit the appearance of an amphitheatre." A co-incidence in a configuration so uncommon when other analogies are also considered, can hardly be viewed as accidental. The soil he describes as a stiff reddish clay. The rock exposed in sea cliffs and in some places at the bottoms of rivers is a species of clay called by the natives *nappal*, which is common in Singapore. The country between the mountains and the eastern coast of Sumatra is little known, but what information has been obtained respecting its geological features I have collected in the paper before alluded to.

canic forces sufficing to elevate the rocks and produce eruptions at different places along the lines of fissure, the system of semi-volcanic hills extending from the termination of the Malayan plutonic chain to Banca would be produced. Whether we admit the notion of a translation of waves or suppose that under the region a general volcanic pressure was in operation, producing an expansive tendency whose superficial manifestations varied according to the mineral structure and composition of the rocky crust and particular local intensity of force, the same results would follow under the assigned conditions.

Having in the above paper had occasion to bring together several scattered notices of recent volcanic action in Sumatra and the west coast of the Peninsula, it may be remarked that some general facts appear which it may be useful to separate from the local matters with which they are mixed up.

1. The advance of a great wave upon the land, is a circumstance common to most earthquakes on sea coasts. Mr. Darwin considers it to be caused by a line of fracture being formed beneath the sea. If there is a consequent sinking of the sea bed along the line, the rush of the waters on both sides to restore the level would occasion first the retirement of the sea from the shore and then the production of a wave rolling in upon the shore. But might it not also be caused without any sinking or even rending of the sea bed? A strong blow beneath the earth's crust imparting a momentary centrifugal tendency would cause the sea above the point or line of impact to rise violently to a height proportioned to the force of the concussion. But this wave would necessarily be partly above and partly below the general level, or have a hollow on each side towards which the neighbouring waters would rush, and thus the same effect be produced along the adjacent coast as in the former case. Mr. Darwin also mentions that places situated on shallow bays suffer great damage from these waves, while those seated close to the edge of profoundly deep water escape. In the same manner the waves of the Indian ocean, on reaching the shallow coast of Sumatra, rise as they advance until they acquire a great height. This is probably attributable to the friction of the bottom retarding the waves while a constant succession press on from the sea behind. When bays are narrow the wave will have a greater tendency to rise

owing to its progressive lateral contraction, as is seen more markedly in bores.

2. The opening of fissures and evacuation through them of black fluid matter. The spasmodic expansion and contraction of fissures continued after the shock.

3. The disruption of portions of mountains or landslips.

4. The elevation of tracts of land.

5. The greater violence of earthquakes on hills. This was observed at Pinang in 1843. Marsden remarks that houses situated on a low sandy soil are least affected, and those which stand on distinct hills suffer most from the shocks.

6. The connection between earthquakes and the condition of the atmosphere. To what is stated by Lieut. Crooke respecting the great drought which preceded the earthquake at Jambi, the following extract from Marsden relative to Sumatran earthquakes in general may be added:—"Earthquakes have been remarked by some to happen usually on sudden changes of weather, and particularly after violent heats; but I do not vouch this upon my own experience, which has been pretty ample." The earthquake of 1843 occurred during one of the longest and severest droughts that had ever happened in Pinang. This drought, which was attended with oppressive heat and occasional hot winds, never before experienced within the memory of the residents, appears to have extended over the northern part of Sumatra.

Note.

When the foregoing paper was written I had not seen the talented and eleborate memoir on Indian Earthquakes by Lieutenant R. B. Smith, which I received by the *Hooghly*. The portions at which I have had time to glance suffice to show that it contains a mine of wealth. The above notices of Malayan earthquakes, however meagre, may serve to connect his researches with the Indian Archipelago, respecting the general geology and recent volcanic disturbances of which I am collecting information. Meantime the subjoined account which has been furnished me by my brother, abridged from the official report of the Alcalde Mayor of the province of Cagayan in the Island of Luzon, of an earthquake attended by the subsidence of two hills and by a violent hurricane which occurred there on the night between the 7th and 8th October last, may prove interesting. It will appear in the

Singapore Free Press, but I presume that will form no objection to its being put on record in the more permanent pages of the Journal.

"The Casa Real of LALLO, a brick-building, and one of the most solid edifices in the province, was destroyed. The rector's house was destroyed, and the roof of the Church suffered much damage, and many other of the public edifices were more or less injured. The Tribunal stood it out well, and will only require a new roof. All the wooden houses were levelled with the ground. None of the attap houses escaped, and the greater part were blown over with many of their unhappy owners in them, and their little stores of paddy. The people notwithstanding, had been since occupied in repairing the serious injuries which the Renta de Tabacos had suffered, and the wages, which were paid daily, served as some consolation to them in the midst of so much misfortune. Five persons are reckoned to have been killed and 11 wounded. In CALAMANIUGAN the Church and rector's house were entirely destroyed, and the priest was living in the Royal Tribunal which had escaped injury, and in which he had erected an altar. The wooden houses suffered more than those of Lallo. The attap houses were all destroyed. The people experienced the misfortune of being caught by the hurricane with the greater part of their grain still on the ground, the whole of which was destroyed. Eleven persons were killed, and 20 seriously injured. At APARRO the majority of the houses in the district are of wood which were mostly all destroyed. The Royal Tribunal, a new and solid building, was overthrown—the rector's house destroyed and the Church much injured. Nearly all the wooden houses were destroyed, and none of the attap ones escaped, the greater part going to block up the river or into the sea, which rose into the village and contributed to make the night more frightful, and to augment the number of victims, who amounted to 27 killed and 53 wounded. All the harvest that had been gathered in perished, being carried into the sea with the houses. The destruction of buffaloes, horses, cows, and other property was excessive. In BUGUEY nearly all houses and buildings were destroyed:—one man killed. The Convent of ABULOG was entirely demolished, the Church lost its roof and belfry, and nearly all the houses were levelled with the ground:—8 persons were killed. To the north of this village, at the distance of 6 miles, there is a high hill on the top of which dwelt a number of natives who pay allegiance

to Her Majesty. These people relate that on the evening preceding the hurricane they felt great and frequent tremblings of the earth,—that at nightfall they began to hear in the midst of it a frightful noise which impelled them to abandon their abode, and fly, full of fear, to a creek for shelter from the fury of the tempest which was increasing :—on the ceasing of the storm, on the morning of the 8th, they returned to their dwelling, when they found that it and the hill on which it stood had sunk,—there appearing in its place a large lake of black water, of a fetid odour, and smoking. In PAMPLONA the Churches and Tribunal were destroyed, as well as the rest of the houses, with the exception of the Church of the division of Masi, which being of very solid construction, escaped with trifling injury; 5 persons were killed. At the entrance of the river of this village there was a hill sixty feet high separating the sea from the river, which having disappeared, the two waters are now joined and a wide and practicable passage opened. Five victims are reported. Within the boundaries of all these districts nature presents a most sombre picture, not a single green tree is to be seen, the thickest trunks alone remaining, and these as if only left at last to show that vegetation had ceased; which is no doubt owing to the great quantity of electricity with which the atmosphere was charged during the hurricane."

(*To be continued.*)

On the Refinage, on a large scale, by means of Nitre, of brittle or understandard Silver, for coinage purposes; and on a ready mode of approximative assaying of silver, by W. B. O'SHAUGHNESSY, *M. D. and F. R. S., Co-Secy. Asiatic Society of Bengal.*

Although the subject of the refinage of silver for coinage purposes may appear of too special and technical a character to warrant my affording to it any portion of the pages of this Journal, it still presents some collateral points of general interest. It affords an opportunity too of conveying in a simple and intelligible form a few observations regarding our silver standard and the approximative testing of silver coin and bullion, which may prove useful to some of the readers of this Journal who have to manage bullion transactions with native states.

The East India Company's new rupee is by law composed of 11 parts by weight of *pure* silver and 1 of copper. A pound of this alloy is divided into 12 ounces, each ounce into 20 penny weights. In the receipt of bullion tendered at the mints, the alloy of 11-12ths is taken as *standard,* and according to the number of half penny weights of *pure* silver, above or below *eleven* ounces, or 220 dwts. the bullion is on assay reported *better* or *worse* than *standard.* The composition of a few of the most remarkable varieties of bullion and coin received at the Calcutta mint will illustrate this statement.

1 ℔ of contains—	Dwts. of Fine silver—	Alloy.	Assay Report.
Standard Silver,...............	220	20	Standard.
Silver Coin of Great Britain,....	222	18	2 Dwts. Better.
New Dutch Guilders,..........	226	14	6 Br.
Old Sicca Rupees,............	235	5	15 Br.
Sycee silver of best quality, ...	236½	3½	16½ Br.
Silver ingots from mint refinery,.	240	0	20 Br. *Pure.*
Spanish Dollars,...............	215½	24½	4½ Worse.
Five Franc pieces,............	216	24	4 Wo.
Nanashaye Rupees of Jaloun, ..	202	38	18 Wo.
Debmohree Rs. of Assam, ...	130	110	90 Wo.

These few instances are sufficient to exemplify the practical range of proportion in the silver and alloy of the bullion usually presented. By the mint rules a charge for refinage is levied on all such bullion, which is alloyed to a greater extent than 26½ parts or penny weights in 240. technically 6½ "worse" than standard.

In alloys however of silver and *copper only,* it is generally found that however large the proportion of copper, the bullion does not require refinage for coinage purposes, if mixed with the requisite quantity of *pure* silver, or superior silver alloyed with copper only. Thus Dollars and Five Franc pieces may be used for alligation without risk of rendering the resulting ingots unmanageable in the subsequent stages of coinage. But if the bullion, whether worse or better than standard contains lead, tin, brass or sulphur in a larger proportion than two dwts. in the pound, it affords ingots which generally prove brittle in the course of manipulation, or give a mixture of uncertain fineness and unfit to be coined. To illustrate this I may mention that I have fre-

quently known Sycee silver at $16\frac{1}{2}$ Br. alloyed with $2\frac{1}{2}$ copper, to yield bars as brittle as slate or cast iron; and these when assayed to prove 2 or even 3 dwts. better than *standard.* This proceeds from the presence of lead or sulphur in the Sycee silver, part of which burning off leaves the resulting mass richer in silver than before, but brittle from the small portion of lead which remains. On the other hand I have still more frequently seen alloys of silver and copper, 50 to 80 *worse* than standard, affording with the due proportion of richer silver, a perfectly malleable and standard metal.

The object of refinages for the mint is therefore usually to remove the lead, tin, zinc or sulphur and to leave the silver and copper, or occasionally, when pure or rich silver is not available, to bring up inferior alloys to standard or even superior fineness.

The process followed by the native refiners in the bazar is that of *cupellation,* and is performed by them with great success and economy. They use for the cupel a mixture of one part by weight of recently burned lime, sifted but unslaked, and two parts by weight of chaff ashes. With this they make a basin like mass, usually eighteen inches in diameter below and 4 to 6 inches deep. This they moisten well with water and beat with the hands into firm consistence. Pieces of brick are placed round the sloping sides to give support, and two pairs of bellows are arranged so that by their alternate use a constant blast of air is kept up during the process.

While still wet the basin is charged with charcoal and an active fire kindled, the silver is then introduced and lead added till all is melted and red hot. Two large logs of firewood are then placed over the charcoal so as to form a dome to the heap, and at the interstices torch-like pieces of wood are continually introduced, so that a powerful flame is reverberated from the blazing dome above.

By this manipulation the lead is oxidized, and the oxyde of lead (litharge) formed is absorbed with the oxides of copper, and other base metals usually present, by the porous mixture of lime and ashes. None of the litharge is removed by skimming. In refining 2500 tola wt.* from 16 "worse" they use 1200 tolas of lead, and the operation is completed in less than 3 hours, yielding a cake of silver 16 to 17 dwt. "better" than standard. The bazar refiners contract to return all the silver according

* The tola is 180 Troy grains. 32 tolas = one Troy pound.

to official assay; and finding all materials, they receive for their labour 8 annas, or ½ per 100 on the value of the metal. The cake of litharge when cold is ground and sifted and yields granules of silver. The sifted powder is made into a paste with cow-dung, and the lead recovered in a furnace of particularly ingenious and effective construction—of which the following is a sufficient description.

A barrel-shaped clay cylinder is made, open at both ends, nine inches diameter below by 12 to 15 above, and usually 24 inches high. A bellows pipe of refractory clay 3 inches in diameter enters at the side about 4 inches from the top, and is led down the cylinder so that the nozzle of the pipe is within six inches of the bottom. The cylinder stands over a cup-shaped hollow made in the ground and sifted over with a little wood ashes. To use this furnace it is first half filled with charcoal and the fire kindled. The mixture of litharge and cow-dung is then introduced in balls the size of an orange, with layers of charcoal and the fire urged. The litharge is quickly reduced to the metallic state, and the lead containing any silver present in solution, collects in the cup-shaped hollow—100 ℔s of litharge can be thus worked off in about 4 hours. This process is applied with remarkable success to the treatment of sweepings and other rubbish containing not more than 1 per 100 to 2 per 100 of silver, but in this case a small and variable quantity of borax is added to the mass of litharge, sweepings and cow-dung.

The basin below the cylinder is open at one side, but during the process is kept partially closed by a heap of charcoal and a brick. This being removed occasionally, the surface of the melted lead is raked free from earthy slags by an iron rod, and the firing is continued till the balls are all consumed. The cylinder is then removed, water thrown on the lead—and this containing silver, is used for the next cupellation refinage.

The skill exhibited by the native refiners in conducting these processes is beyond all praise, and for the scale on which they have to operate, it would, I conceive, be scarcely practicable to effect any improvement on their system. But it has serious inconveniences when we attempt to follow it in large operations. Each operation is limited to about 2500 tola wt. and this may be repeated, so as to give 5000 as the day's work of 6 men. The heat is almost intolerable, the lead fumes most dele-

terions. These objections might be obviated by the erection of suitable screens and hoods, but the refinage never proceeds so successfully as when the native operator is left to his own fashion. Superintendence and the prevention of pilfering become exceedingly difficult also when a large quantity of bullion has to be operated on, from the great number of people employed, the large space occupied by each gang, and the dense smoke and fumes which fill the refinery.

In the new mint there are three cupellation furnaces by Maudslay, constructed on the most approved plan, and in which the operation could be carried on very effectively and economically were it practicable to work the furnaces continuously, night and day; but as all work must terminate in the mint and the fires be extinguished daily at 4 P.M., the furnaces are quite useless. At best no more than 3000 tola weight of silver can be refined in each daily, but with such wasteful expenditure of fuel as to render the operation much more costly than the charge of the native refiners.

The cursory description above given suffices to explain the object I had in view in attempting, towards the close of 1845, to effect the refinage of silver in large, indeed, I may say immense quantities, and to conduct the operation so that the mass of bullion acted upon should be brought into a malleable state, *and safely stored,* within a period of six or seven hours. How effectually this has been accomplished is shown in the sequel of this paper.

My process is based on the old French system of the *poussée* or saltpetre refinage. This I witnessed in the Laboratory of my friends, Messrs. Johnson and Cock, the eminent refiners in London, and it is minutely described in the works of Dumas and Berthier. The silver to be refined is granulated, the granules mixed with one-tenth their weight of fine saltpetre, and projected gradually into a redhot EARTHEN crucible. The nitre oxydizes the base metals, having but little effect on the silver—when the mass has become red hot the fire is urged till the silver is melted; the whole is then poured into ingot moulds; and the scoriæ, consisting of potash, oxides of copper, lead and other base metals, with granules of silver and oxide of silver in considerable quantity, are reserved for subsequent treatment by methods varying according to circumstances afterwards explained.

The practical drawback to this system as it existed previous to my experiments, was the supposed necessity of using *earthen* crucibles.

This at once limited each batch to some 30lbs weight of metal, or about 1000 tolas, and where we had to deal with tons and lacs its adoption seemed hopeless. It occurred to me however, to make trial of the ordinary cast-iron melting pots of the mint, and I soon found to my great satisfaction that by a little management these could be used with complete success. The object in view was accordingly gained to the fullest extent required, and in September, 1846, this system of refinage was applied in one working-day (the 4th Sept.) to the very large quantity of 188,264 tola wt. of coarse silver—Troy pounds 5,883, value Co.'s Rs. 172,860 10 2, or £17,286 1*s.* 3*d.* which was refined and returned to the mint in bright malleable ingots, and registered for assay in less than six hours from the commencement of the operation. I believe I am justified in asserting that in point of rapidity, economy and quantity, this day's refinage has never been equalled in any refining establishment in any part of the world. I now proceed to the detailed description of the process—its expenses and total results.

The cast-iron silver melting pots used in the mint, are of cylindrical shape, with round bottoms, 17 inches external height, 11⅛ inches, internal diameter, 1¼ inch thickness of metal. The quantity of silver usually melted in each pot is 10,000 tola wt. or 312½ Troy pounds. If the silver to be refined is in the state of coin the operation may be commenced at once. If in bars or other solid masses it must be granulated. For this purpose about 8000 tola wt. are melted and poured from the pot placed on a suitable frame over a tank of water, beneath the surface of which two or three brooms are kept in constant motion. This reduces the silver to granules like small shot.

6000 tola wt. of understandard coins or granules are placed in each iron pot, and heated to low redness in the ordinary melting furnace, of which there are 16 in the mint. When at a low red heat the mass of silver is hollowed out with an iron rod with flattened end, so as to make a funnel-shaped depression of the metal in the centre. About 2 pounds weight of saltpetre are thrown into this hollow. The saltpetre rapidly melting percolates through the granules or coins, and, as it filters through parts with its oxygen to the base metals. After a few minutes the fireman with the same rod stirs up the silver from the bottom of the pot and works it in every direction, again cupping the centre as before. The heat is slightly urged and the saltpetreing is

repeated in the same manner, until from 5 to 7 seers (10 to 14lbs) are used, the quantity being determined by the coarseness of the silver. In half an hour from the beginning the whole mass of metal becomes pasty, and when pressed towards the bottom of the pot coheres in a mass upon which there floats a very liquid scum, composed of melted potash and litharge with some oxide of copper and a little oxide of silver in solution. *This liquid scum is skimmed off with an iron ladle*, and when as much is removed as is practicable, the pot is covered and the fire run up by the register to a degree somewhat higher than that usually given in silver meltings, and which experience can alone teach.

In about half an hour the silver is found to be quite melted, its surface being covered with thick but loose and dry crusts of oxide of copper. It is now ready for pouring, and a piece of coke being placed across the lip of the pot, the refined silver is cast in ingots in the usual manner, without any of the dry scoriæ entering the moulds. The ingots when cool are perfectly clean and bright, and fit in every respect for delivery in the Bullion department, to be registered for assay.

On the 4th of September 1846, this process was, as above stated, performed on silver to the value of Co.'s Rs. 172,860 10 2,=£17,286 1*s.* 3*d.* sterling. At 8½ A. M. the fires were lighted in the 16 furnaces. At 9½ A. M. the silver (consisting of Nauashaye rupees, average 18 *worse* than standard, and containing about 4 dwts. of lead per lb.) in the state of coin was charged into the pots—at 10 A. M. the saltpetreing was commenced—by 11½ the first pot was poured off, and all sixteen by ½ past 12. The pots were replaced in the furnaces, charged once more and by 2½ P. M. the refined silver again poured off. The refined bars were returned to the mint. The subsequent assays showed some of the pots to have been refined to 13 dwts. *better*, and the whole silver returned averaged 5 "better." All the ingots without exception were soft and malleable and fit for alligation.

When the scoriæ and sweepings were subsequently worked up, and the account closed, it was found to stand as follows:

Value of silver delivered to be refined Co.'s Rs.	172,860	10	2
Returned refined silver, value, ...	172,488	10	3
Loss, Rs.	371	15	11

Being three annas and five pie per cent. in value, or about $\frac{1}{5}$th per 100, which was found by experiment to be the mere loss on melting this kind of silver.

From the 9th of October 1845, to the present time, May 1847, I have refined in this manner coarse and brittle silver to the value of over ten lacs of rupees=£ 100,000; of the Jaloun silver alone there were refined in 1846 Rs. 882,510 11 8. In one operation about Rs. 50,000 worth of silver, containing over 30 per 100 of *lead* was thus treated, and the resulting ingots, though 40 to 50 dwt. *worse* than our standard, were cured of brittleness and rendered fit for alligation for coin.

From these numerous and large trials it results that when the saltpetreing is managed in the mode I have described, the iron vessel is entirely uninjured. In fact the saltpetre has become inert before it touches the side or bottom of the pot. Accordingly the same pot has in many instances been used more than six times over, and after this has borne the average number of common meltings, as shown by the official report of Mr. Casperz the melter to the mint.

Treatment of the Scoriæ.

This part of the operation is done at leisure, and on its careful and precise management depends the economy of the process.

The scoriæ well mixed together may be represented as composed of fused potash, oxides of copper and base metals, granules of metallic silver with oxide of silver, and a minute quantity of chloride of silver.

The mass is first bruized in iron mortars and steeped in water for two days in a leaden tub, the water then drained off and replaced, and this repeated a second time. The potash is thus dissolved out, the mass disintegrated and rendered pulpy, and its oxide of silver reduced to the metallic state. It is now in successive portions rubbed in iron mortars, and sieved on fine cane or bamboo sieves floating on water in the leaden tub. The pulp of oxides passes through, and nearly all the silver in granules remains on the sieve. This silver only needs to be melted and returned.

The oxides, with finely divided metallic silver, metallic copper, and chloride of silver, after settling to the bottom of the tub, and the water decanted or syphoned off, are placed on dry tiles, which soon absorb the moisture; of this mass from 4 to 5 cwt. weight are placed in a reverberatory furnace and calcined at a low red heat for four hours.

This converts the metallic copper into oxide of copper. When cool the mass is boiled, 100 lbs. at a time, in a leaden boiler, for about an hour, with 40lbs of sulphuric acid and 200 lbs of water. Most of the copper is thus recovered in the state of sulphate of copper solution, which is poured off into tanks to crystallize. What is undissolved by the acid is tile-dried, and a small portion, about ten tola weight, of the residue melted for trial. If the trial ingot is malleable and soft the whole mass may now be melted into ingots to close the account. For although these ingots will be much *worse* than standard, they are free from lead and devoid of brittleness, and consequently fit for alligation. On the other hand if the trial ingot be brittle the mass should be again roasted and treated with sulphuric acid as before. And according to the original quality of the silver this may need three such operations.

In refining 100,000 Rs. value of such understandard coin, about 90,000 Rs. value will be returned at once refined above standard—5000 will be found in granules—4000 to 5000 will be recovered by roasting and by sulphuric acid, and from 500 to 1,000 will remain as chloride of silver and very finely divided metallic silver, which is slowly deposited from the sulphate of copper liquid, as a white slime or mud, consisting of the chlorides of silver, copper and lead, sulphate of lead and metallic silver. This mud is tile-dried and treated as follows:—

100 parts by weight are well mixed with 50 of dried carbonate of soda, and 20 of powdered charcoal, the mixture melted in black lead pots and poured into conical moulds—on cooling a mass of lead containing all the silver is found at the point of each cone. This lead usually contains 20 to 25 per 100 of silver, and the precious metal is extracted by cupellation. The quantity of argentiferous lead to be cupelled from the refinage of 100,000 tolas of silver will range from 2000 to 4000 tola weight. If black lead pots are not available this part of the operation may be conducted successfully in the native cylinder furnace above described, merely substituting cow-dung for the charcoal, and mixing the mass into balls.

By careful attention to the above description no failure or difficulty need be dreaded in large silver refinages. The advantages of the process may be briefly summed up—rapidity, economy, salubrity and safety of the bullion. Before this method was introduced in the Calcutta mint the refinage of silver to the value of a lac of rupees was the work

of six weeks to two months. It can now be effected in four hours. The sulphate of copper removed in clearing up the scoriæ is in another department of the mint brought to yield the copper it contains in an absolutely pure state, so enhanced in value that it sells for 44 Rs. the maund of 100 Troy pounds, and thus pays for the saltpetre, acid, fuel, wages of workmen and melting losses. The poisonous fumes of the lead cupellation are avoided—and the rapidity with which 95 per 100 of the bullion is returned to the mint strong room, being taken there directly from the furnace, reduces the risk of loss by pilfering to an insignificant amount. The importance of this can only be estimated by those who may have to manipulate large quantities of bullion with native workmen and overseers, under whose care silver is apt to acquire the volatility of mercury, and disappear in a way that would appal a refiner only accustomed to the habits of the metal in European establishments. Against this cause of loss experience teaches me there is no safeguard but the concentration of the processes under the director's eye, the employment of the smallest possible number of persons in the manipulation, and the return of the bullion under refinage with the least avoidable delay.

[*Assay of silver.*]

In the commencement of this paper I alluded to our silver standard, and to my desire to afford a few useful hints to officers having bullion transactions with native states. Vast sums are annually paid in native coinages of almost innumerable variety, of which the Nanashaye and Balashaye rupees of Jaloun and the Deb-mohree rupees of Assam may be cited as examples. It may be confidently stated that whatever be the nominal fineness of these coins, the practice of the native mints is to debase as much as possible, and their workmen are moreover well acquainted with all the arts of pickling and blanching, hot stamping, &c. which give the debased coin a most respectable surface. Some ready method of assay, not affecting to be exact, but one closely approximative, would, I have been often assured, be deemed of much utility to many public officers in the transactions referred to. Such a method I take this opportunity to describe, prefixing a few words on the exact systems of assay followed in the mints.

In the English and Indian mints the ancient process of cupellation is followed. Through the great kindness of my friend, Mr. Dodd, the

present Assay Master, I have been enabled to convince myself that in skilful and conscientious hands this method ensures all the accuracy which is required in the operations of the mint and for commercial purposes. Its range of error will not exceed 2 parts in 1000, and be still within the deviation permitted by the law with reference to the impossibility of ensuring an exact mathematical alloy in all minting operations. But this system of assay demands the appliance of so much skill and such cumbrous apparatus that to the experimentalist " in the jungle" it affords no resource.

The French method, by solution in nitric acid and precipitation of the silver as chloride by common salt, is only applicable where the silver under assay is alloyed with copper only. If it contain lead, mercury, tin or iron, the results are fallacious. I enter upon no details, as I am not addressing these remarks to assayers. It is enough to say that the solution becomes so milky from the presence of chloride of lead, calomel, or peroxide of tin, that it is impossible to see and note correctly when the proper quantity of the salt test-liquor has been added; or on the other hand, if the experimentalist desires to weigh the precipitate, he is liable to be deceived by the quantity of insoluble chlorides of base metals united with that of silver.

I pass therefore to another and a ready resource, which only requires a Florence flask or two and a little nitric acid for its performance, and by which the experimentalist may proceed as follows:—

Weigh 24 grains of the silver to be examined, and dissolve it by means of one fluid drachm of *pure* nitric acid, about sp. gr. 1350, and half an ounce (fluid) of rain or distilled water. When dissolved dilute the fluid to two ounces with distilled water and introduce a clean slip of *pure* copper. Boil the contents of the flask over a lamp or on a pan of sand over a charcoal fire, so long as silver is deposited on the copper, and until a fresh slip of copper introduced is not tarnished—then let the liquid settle, decant the blue liquid, replace with water, decant once more, placing the thumb on the mouth of the flask invert it and let the silver escape upon a small China saucer—let the moisture drain off and dry the silver thoroughly over the hot sand. Weigh it now in your medicine chest scales, which ought to turn fairly to $\frac{1}{10}$th of a grain or less. Now if your silver be the Company's standard, the 24 grains (= to 24.00) should give you 22.00. An English shilling

should give 22.20 ; an old Sicca rupee 22.15,—each tenth of a grain being the equivalent of one dwt. If more than 22.00, the silver is better, if less than 22.00, it is worse than our standard. But the silver obtained in this experiment is usually somewhat heavier than it should be, being associated with a little copper. The error is nearly compensated by the slight loss in the manipulation, and moreover it does not amount to more than one dwt. of excess. This may be safely allowed for, and the extempore assayer may rest satisfied that he knows the true value of his silver within 1 per 100. Thus for example, he dissolves 24 grains of a Debmohree rupee, and he finds his dry silver weighs 13 grs. It is therefore 9.0 grs. (or 90 dwt.) worse than 22 grs. which should be the standard. Now as 24.0 :: 13.0 :: 100 :: 54.16, or 100 tolas of this silver contain *fine* silver 54.16 = 59.08 Co.'s Rs. But if an error had occurred increasing the weight of the silver precipitate to 13.20 the per centage of fine silver would be $55.00 + \frac{1}{11}$ alloy = to Co.'s Rs. 60, the difference being 0.84 per 100 on the fine silver, or 9-10ths of a rupee. But in the transactions to which these remarks bear reference an error of even one per 100 at either side is of but insignificant importance, the object being merely to obtain a good approximation, not an absolutely correct result.

The use of *pure* copper is essential for this simple process, inasmuch as the impurities of the metal usually met with may lead to very deceptive results. I shall be happy to supply any reader of this paper with electrotype copper in sufficient quantity to enable him to try his skill as an amateur assayer—for *pure* nitric acid I must refer him to the Hon. Company's Dispensary, or to any of the eminent Calcutta druggists.

Observations on the Ovis Ammonoides of HODGSON, *by Capt. T.* HUTTON, *F. G. S.*

Having lately procured a pair of skins of the (so called) "*Ovis Ammonoides*" of Hodgson, and as the specimens are both in winter pelage, as indicated by the beautifully soft wool under the hair, it may be interesting to compare the description of them with that lately published by Mr. Hodgson, in the Journal Asiatic Society, No. 173 of 1846.

"*Ovis Ammon*"*?* Pallas. vel. "*O. Ammonoides,*" Hodgson. The "*Nian*" or "*Nyan*" of the Bhoteahs.—(Pronounced nasally in one syllable.)

Measurement of a male of five years, according to the markings on the horns;

	ft.	ins.
From nose to base of horns, ...	1	1
Thence to insertion of tail, ...	5	1
Tail to end of hair, ...	0	3
Total, . .	6	5

	ft.	ins.
Circumference of horn at base, ...	1	$4\frac{3}{4}$
Length on the curve, ...	2	$10\frac{1}{2}$, tips broken.

Winter pelage; above deep brown interspersed with grey, with a distinctly marked darker dorsal line, passing, (as in *O. montana*) in a narrow stripe through the disc on the croup, even to the tip of the tail. Sides mixed hoary or slatey grey brown; disc on the croup well defined and dirty white, the hair appearing as if rubbed. The throat and neck beneath to the breast, white, sprinkled with scattered brown hairs; the hair long, bushy and pendent; and from 6 to 7 inches in length, while that of the back is barely 2 inches, except on the dorsal line, where it is 3 inches, and on the ridge of the neck above $3\frac{1}{2}$ inches. Tail, above, brown; whitish at the sides, naked beneath. Under parts dirty white; medial line blackish; outside of the limbs with a dark list; lips, whitish; face, paler brown than the body.

Front surface of horns, ...	$3\frac{1}{2}$ inches wide.
Inner lateral surface, ...	6 inches wide.

Measurement of the bare skull of a male 7 years old;

	ft.	ins.
Length of face to base of horns, ...	1	1
Length of horn on the curve, ...	2	10
Basal circumference,..........................	1	$4\frac{3}{4}$

These horns are weathered and much broken at the tips, and were probably about 3 ft. 3 inches long.

Description of a female, 6 years old by the marking of the horns;

	ft.	ins.
Nose to base of horns, ...	0	10½
Thence to insertion of tail, ...	4	5
Tail, ...	0	3
Total, ...	5	6¼

	ft.	ins.
Length of horns on the curve, ...	1	4½
Basal circumference, ...	0	8

In the female the colouring is lighter than that of the male, having more grey; and the throat and foreneck are slatey instead of white, and devoid of the long pendent frill which graces the other sex; the dark dorsal line, which in the male runs in a narrow stripe through the pale disc, ends in the female at the commencement of the disc, and the tail and croup are of the same canescent fawn colour; the disc is far more extensive than that of the male. Along the ridge of the neck above, from the base of the horns to about 10 inches beyond them, there is a mane of true woolly hair 6½ inches long, gradually fading into the crisp quilly hair of the dorsal line. There is no dark list down the outside of the limbs, but the colour is pale fawn.

	ins.
Front surface of horns, ...	1¾ broad.
Inner lateral surface, ...	3 inches.

In both sexes there is a beautifully soft inner coating of fine pushmeena wool of a pale mouse colour.

The height of the animals I have not given, as the limbs are defective in my specimens.

The above measurements were taken with care, and although my male appears somewhat superior in size to Mr. Hodgson's, the general correspondence is evident enough.

	ft.	ins.		ft.	ins.
Mr. Hodgson's male over all is, ...	5	11¼	mine	6	5
Ditto ditto to base of horns, ...	1	0	ditto	1	1
Ditto ditto basal circumference, ...	1	3½	ditto	1	4½
Mr. Hodgson's female over all, ...	5	6¼	mine	5	6½
Ditto ditto to base of horns, ...	0	11	ditto	0	10½
Ditto ditto basal circumference, ...	0	8	ditto	0	8

This species appears to differ from "*Ovis montana*" of America, in having the hair on the throat elongated into a pendent fringe, while in the latter species, as described in Griffith's Synopsis, it is distinctly stated that there are "*no long hairs under the throat.*" Dr. Richardson (as quoted by Mr. Blyth in No. 35, J. A. S. for 1841) states in speaking of the Rocky Mountain Sheep, that "as the ends of the hairs (in which the colour resides) are gradually rubbed off during the progress of the winter, the tints become paler, and the old rams are thus almost white in the spring." In the male specimen before me, this could not take place, for the colouring instead of being confined "to the ends of the hairs," pervades them, though less intensely, to the base, and the animal by rubbing would assume a slatey grey hue, except on the throat, disc, and belly, where it would be white. In the American species again, the tail is said to be 5 inches long, whereas in the Thibetan animal it is only 3 inches, and the length from nose to tail appears to be superior to that of "*O. montana.*"

On the other hand it would appear to agree very well with the descriptions of "*Ovis Ammon,*" except, that Col. H. Smith states, that the female of that species *wants the disc on the croup*, while in my specimens the pale disc of the female is larger and more conspicuous than in the male.

Secondly, in the Synopsis, the horns are said *to touch* on the forehead, while in Mr. Hodgson's description they are $\frac{1}{4}$th of an inch apart, and in my specimen they are $\frac{6}{8}$th of an inch apart;—in the bare skull they are $1\frac{1}{4}$ inches apart. This character however is nullified in the text, where it is said that they are "*nearly touching.*"

Thirdly, it is stated that the horns of "*O. Ammon*" have "*the broadest side towards the forehead,*" and if this means *towards the front,* as I suppose it does, then it would seem to prove that our animal is distinct from *O. Ammon,* inasmuch as its horns have the *narrowest* side to the front,—the base of the triangle being $3\frac{1}{2}$ inches, and the inner side 6 inches wide! "*O. Ammon*" is likewise said to be "*nearly five feet in length,*"—whereas the Bhotan species is *more than* 6 *feet in length!*

Unless therefore these published characters of *O. Ammon* can be satisfactorily proved to be incorrect, it would appear that Mr. Hodgson has good and sufficient grounds for declaring the two animals to be

distinct, and therefore for establishing his "*Ovis Ammonoides.*" The point can only be determined by those who may have the opportunity of comparing specimens of both.

On the Hispid Hare of the Saul forest.—By B. H. HODGSON, *Esq.*

Lepus hispidus. Pearson.

Caprolagus hispidus. Blyth.

Habitat, The great forest at the base of the Sub-Himalayas and of their offsets, from Gorakpur to Tipperah.

Having been recently so fortunate as to obtain a fine living pair of the Hispid Hare of the Saul forest, together with some trustworthy information about the habits and location of the species, I purpose to give the results of my examination and inquiries to the Society, the animal being extremely rare, and moreover being one of those species the right understanding of which, in relation to its congeners, is calculated to throw light upon the difficult question of the true nature and limits of generic aggregations.

The sub-Himalayas and that portion of their south-eastern continuation dividing the basins of the Irawadi and of the lower Bruhmaputra, are accompanied all the way from the point where the Ganges intersects them to the sea, by a vast forest which forms their skirt towards the plains of Hindostan and Bengal. This forest, which is one of the largest and most unbroken in the world, having a breadth or depth of from 10 to 20 and even 30 miles throughout its extended course of some 1500 miles, and being inhabited only in spots here and there, is one of the most important features of the Geography of India for the zoologist, owing to the number of animals that are now peculiar to it, because they have found probably in its immense malarious recesses a last refuge from the gradual encroachments of man. Swainson observes that there are no forests or tenants of the forest like those of the new world: but those who have followed the Gaur and Elephant, the Arna and Rhinoceros, the Samber and Barasinga though the 'Saul forest' as above defined, have felt little disposition to acquiesce in that remark. The popular designation of Saul forest is derived from the prevalence of that

Pl. XIV

T. Black Asiatic Lithc Press Calcutta

THE HISPID HARE *of the Saul Forest.*

stately and valuable timber tree (Shorea robusta) throughout the tract in question, except near the sea, where it is replaced by the Teak, which may be aptly denominated the pelagic saul.

This primeval forest is the peculiar and exclusive habitat of the Hispid Hare, a species that never ventures into the open plains on the one hand, or into the mountains on the other; and hence it is so little known, deep cover and deadly malaria contributing alike to its happy obscurity. As the black-necked Hare or Nigricollis is the single species of the Deccan, and the Red tail Ruficaudata of Hindosthan and Bengal, so is the Hispid of the vast sub-Himalayan forest; and it is remarkable that the mountains beyond the forest, even up to the perpetual snows, have no peculiar species, the Red tail of the plains being alone found there. Two specimens only of the Hispid Hare are yet on record.* These were obtained respectively on the banks of the Tista and in Assam. My two were got near the Cosi, and recently. Previously I had never obtained a specimen, though I have often heard of and even seen the animal as far west as the Gandac, and information on which I can rely convinces me that the species extends, within the saul forest, as far westerly as Gorakpur, and as far east and south as Assam and Tipperah. The Hispid Hare is a habitual burrower, like the Rabbit; but, unlike that species, it is not gregarious, and affects deep cover, the pair dwelling together, but apart from their fellows, in subterranean abodes of their own excavation, and having, it is supposed, two or three broods in the year, consisting of one or two young each time. Less highly endowed with the senses of seeing and hearing than the common hare or rabbit, and gifted with speed far inferior to that of the former or even of the latter species, the Hispid Hare is dependant for safety upon the double concealment afforded by the heavy undergrowth of the forest and by its own burrow, and accordingly it never quits the former shelter, and seldom wanders far from the latter, whilst the harsh hair of its coat affords it an appropriate and unique protection against continual necessary contact with the huge and serrated grasses, reeds and shrubs in the midst of which it dwells, and dwells so securely that it is seldom or never seen even by the natives, save for a short period after the great annual clearance of the Tarai by fire. The Meeches, to whom I am indebted for my specimens, call the

* Sporting Magazine, August, 1834. Asiatic Journal No. 160 of 1845.

animal the Black Hare or Saul forest Hare, both excellent names—and they tell me that it feeds chiefly on roots and the bark of trees, a circumstance as remarkably in harmony with the extraordinary rodent power of its structure as are its small eyes and ears, weighty body and short strong legs, with what has been just stated relative the rest of its habits. The whole forms a beautiful instance of adaptation without the slightest change of organism; for neither in the hard nor soft anatomy of the forest Hare is there the least essential deviation from those of the Hare of the open country, but only a modification of the same type suited to the peculiar life of each, as respective tenants of the open and cultivated country and of the rude and dense wild. Why the Hare of the plains, and not that of the forest, should pass into the mountains, apparently so much better suited to the latter species, we cannot conjecture: and, though this fact is an argument in favour of considering the Hispid or forest Hare as a separate type—an argument that may be yet further sustained by those differences in external form which very noticeably segregate it from the common Hares of England and of Hindosthan (Timidus and Ruficaudatus), yet, on the other hand, its essential anatomical identity with these animals, and the manner in which the marked diversity of external form just noticed, as well as other peculiarities of habit above recorded, are gradually lost as we pass to other species of true Hare, are arguments of weight against any generic or sub-generic separation. In the Timid and red-tailed Hares the long ears, the large eyes, the frame as well suited to extreme speed as the eyes and ears to effective vigilance, are certainly in remarkable contrast with the small eyes and ears, heavy frame and short equal legs of the forest hare: but all these distinctions, as well as those of domicile, become less and less tangible in the variable Hare, the Rabbit, the Tolai, and the Tapiti,* in which moreover we have variously reproduced, even to the subordinate peculiarities of the Indian forest Hare, such as its white flesh, its short tail, its subterranean retreat and creeping adhesion thereto, so unlike the dashing career of the red-tailed and English species. With these few remarks upon the propriety or otherwise of separating the Hispid Hare from his congeners, I now proceed to what will more fully illustrate that point, viz. a

* See Shaw, Vol. II. voce Tolai and Regne animal ad locum and Naturalist's Library, Vol. xiii. Pl. 28.

careful description of my specimens. They consist of a male and female of mature, or advanced age rather, and they were taken together, when in full fur in February. They were very impatient of confinement and died very soon, owing to injuries inflicted on themselves by vain attempts at escape. I describe them as they lie before me, dead, with fine specimens of the common hare and rabbit beside them. The sexes are as near as possible of the same size and colour; but, if anything, the male is rather the larger and darker. The male measures $19\frac{1}{2}$ inches from snout to vent—head to the occiput, 4; ears to the lobe $2\frac{7}{8}$; to the crown $2\frac{3}{4}$; foreleg from elbow to end of longest toe nail $4\frac{5}{8}$. Hindleg from true knee to longest nail $7\frac{1}{2}$. Planta from heel to long toe-nail $3\frac{7}{8}$; heel to knee $4\frac{1}{4}$; scut only $1\frac{1}{8}$; scut and hair $2\frac{1}{8}$; weight $5\frac{1}{2}$ lbs. The female is 19 inches long and $5\frac{1}{4}$ lbs. Both have a girth behind the shoulder of 12 inches: but the female's tail is the longer, being 2 inches, or 3 with the fur. Her other proportions are almost identical with the male's. Compared with the common species, which lies beside them as I write, these animals are conspicuously of darker hue and heavier make, but not larger. They have heavier heads, much shorter ears, smaller eyes, shorter tails, limbs shorter, stronger and less unequal—in that respect like a rabbit—and, lastly, their mystaceal tufts are much less, and their fur much harsher. Looking closer into their structure it is observable that the profile of the head is less curved in the Hispid than in the common species, the nails somewhat larger, and the digits slightly different in gradation, the thumb in particular being less withdrawn and the little finger more so, from the front, in Hispidus. But the nails have no peculiarity of conformation and so far from being "very acute," they are very blunt and worn. The nose and lips agree precisely with those of the common species: but the eye is conspicuously smaller and placed less backwards, or midway between the snout and ears. The ears both in male and female considerably exceed one half of the length of the head, and are broader as well as shorter than in Ruficaudatus or Timidus; and it is remarkable that the tail in the male is shorter than in the female —in both more so than in Timidus. The teats are six, two pectoral, and four ventral, just as in Ruficaudatus; and the sculls and teeth of the two species are framed upon precisely the same model, general and particular, with this only and striking difference that the skull of the

forest Hare possesses greater strength and solidity with proportional augmentation of the teeth, but especially of the incisors. The skull is rather higher but scarcely so long as in the red-tail. It is also less curved along the culmenal line: the nasal bones are shorter yet more advanced to the front: the solutions of continuity in the bone of the cheeks and palate are smaller; the alœ of the frontals less developed, and the frontals consequently not sunk between them as in the common Hare and Rabbit: lastly, the groove in front of the upper incisors is continued to their cutting edge so as to notch it. But with all these minute diversities there is a remarkably perfect conformity to one model of conformation even in minutiæ. So too in the internal viscera of the two species, though here the disparity appears somewhat greater and more material, for the intestinal canal of Hispidus is much shorter, the difference being, however, compensated in the greater size of the cœcum and of that portion of the intestine which resembles the cœcum. The stomach also exhibits a greater tumidity and thickening near the pyloric orifice, where there is less of these features, or, instead of them, merely a syphonic bend, in the red-tail and rabbit. The particulars of the viscera are set down in the sequel in figures, and I have only further to remark that the bicornate uterus, which in my specimen was unimpregnated—has precisely the character of the same organ in the red-tail; and that the diversity of the other viscera is the less important in as much as several individuals of the same species are apt to show much inequality in this respect, as I have proof before me in regard to the common Hare and Rabbit. With reference to the nature and colours of the fur in the common and forest species, how striking soever the differences at first sight appear, they diminish on closer inspection, for the structure of the hair is exactly the same in both, only with greater thickness and consequent strength in Hispidus; and the hues and their distribution into rings are surprisingly alike, with these differences merely that the rufous tints are deeper toned or browner; and that the dark shading is deeper and fuller, in Hispidus, owing chiefly to the greater abundance of the longer and wholly dark portion of the hairy piles. I have examined the hair and fur, both as to form and colours, with great care; and the above is the result. The general effect may be said to be that the Hispid Hare, as to colour, is of a dark or iron-grey with the ruddy-tinge embrowned, and the limbs shaded outside, like the body, with black, instead of being unmixed rufous.

Dimensions of	*Male.*	*Female.*
Snout to vent,	1 $7\frac{1}{2}$	1 7
Head to occiput,	0 4	0 4
—— Greatest depth,	0 $2\frac{1}{2}$	0 $2\frac{3}{8}$
—— Snout to eye,	0 2	0 2
—— Thence to base of ear,	0 $2\frac{1}{4}$	0 $2\frac{3}{16}$
Ear from anteal base,	0 $2\frac{7}{8}$	0 $2\frac{7}{8}$
—— From crown of head,	0 $2\frac{3}{4}$	0 $2\frac{3}{4}$
Foreleg, elbow to long toe-nail,	0 $4\frac{5}{8}$	0 $4\frac{5}{8}$
—— Palma and nails,	0 2	0 2
Hind leg, knee to end toe-nail,	0 $7\frac{1}{2}$	0 $7\frac{1}{2}$
—— Knee to os calcis,	0 $4\frac{1}{8}$	0 $4\frac{1}{4}$
—— Os calcis to toe-nail,	0 $3\frac{7}{8}$	0 $3\frac{7}{8}$
Girth of chest,	1 0	1 0
Weight,	$5\frac{1}{2}$lbs.	$5\frac{1}{4}$lbs.

Length of Intestines.

	Small.	Great.	Cœcum.
Male,	5 2	4 8	1 $8\frac{1}{2}$
Female,	6 4	4 6	1 10

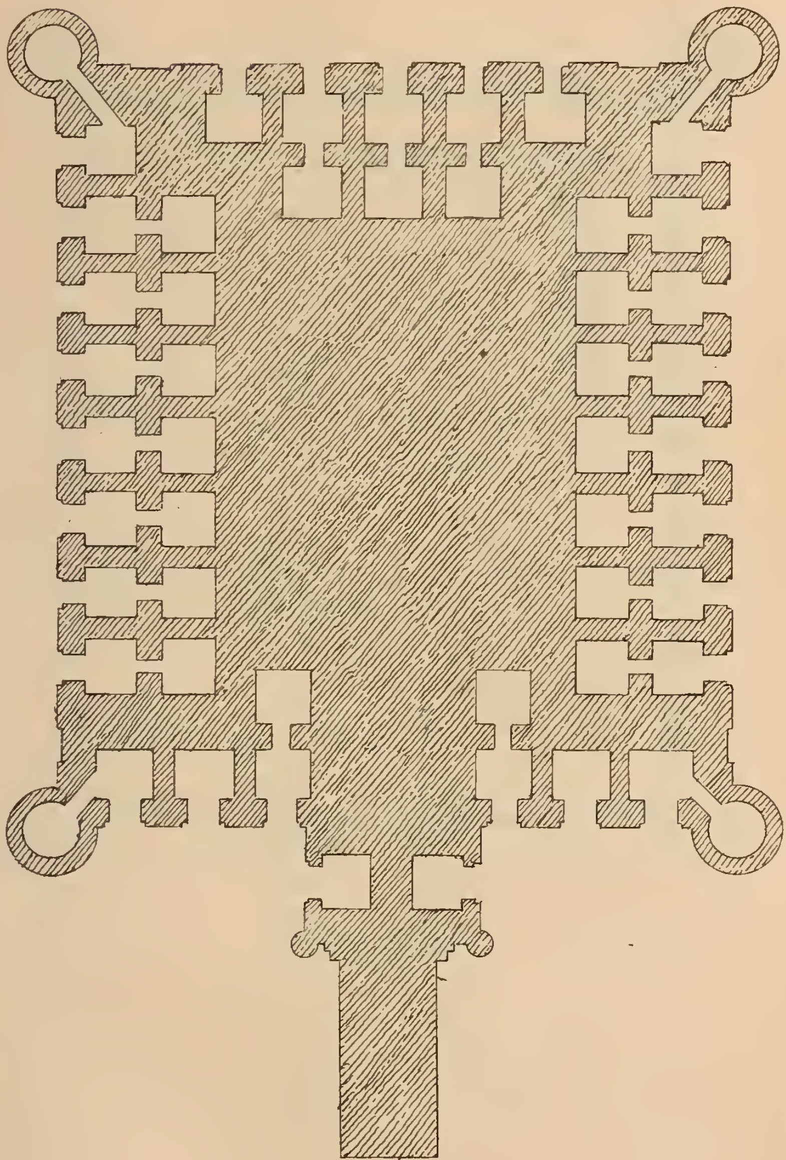
The cœcum is $2\frac{1}{4}$ to $2\frac{1}{2}$ wide, and 20 to 22 inches of the great gut next it are of like width and similarly sacced. The last 4 to 6 inches of the cœcum are simple and narrow. Average width of intestines $\frac{3}{4}$ inches, exclusive of wide part.

Some account of the "Kalán Musjeed," commonly called the "Kalee Musjeed," within the new town of Dehli, by Lieut. Henry Lewis, *Artillery, Deputy Commissary of Ordnance, and* Henry Cope, *Esq.**

The historian says of Feeroz Toghluk, that during a reign of thirty-eight years "he built fifty dams across rivers, to promote irrigation; forty mosques; thirty colleges; one hundred serais; thirty reservoirs for irrigation; one hundred hospitals; one hundred public baths, and one hundred and fifty bridges, besides many other edifices for pleasure or ornament."—*Elphinstone's History of India, Vol. II. p.* 71.

* Communicated by the Archœological Society of Delhi.

The distinguished writer here quoted remarks that the round numbers, as well as the amount, of some of the items, suggest doubts of the accuracy of this list, but that the works of Feeroz, which still remain, afford sufficient evidence of the magnitude of his undertakings. The evidence around, and even in Dehli, of the truth of this remark, is most striking; aud though the whole of the structures which bear the impress of his period, may not have been, and probably were not, erected by this king architect himself, it is more than probable that the building mania in which he indulged, induced the great officers around him to follow his example, and thus earn a sure way to royal favor. In this manner the king may have obtained credit for many edifices which iu reality owe their existence to the emulation he created. The inscriptional evidence of those times is, unfortunately, so very scanty, that this is a point which it must be extremely difficult to settle, and therefore that which is obtainable is the more valuable and deserving the particular attention of the Archœologist. Among the most perfect specimens of the age of Feeroz Toghluk (Feeroz III. of the historians) is the large mosque, within the walls of the present town of Dehli (Shajehanabad) known commonly as the Kalee Musjeed, or black mosque; but this designation, though there are grounds for believing it to be one of long standing, is in all probability a corruption of Kalán Musjeed, or chief mosque, in contradistinction to several smaller ones, said to be six in number, popularly reported to have been founded at the same time, and by the same person as the Kalán Musjeed; one of them exists at the present moment, though in a dilapidated state, at no great distance outside the walls of Dehli, between the Ajmeer and Lahore gates, and which has been converted into a lime-kiln and storehouse for fuel. The Kalán Musjeed is situated near the Toorkman gate of the town, in the Toorkman Thannah, and in the neighbourhood of the celebrated shrine of Toorkman Shah, of which some account may hereafter be given. It is built on ground somewhat higher than that which surrounds it, and, with the exception of the Jumma Musjeed and the gates of the palace, is the most prominent structure in the city of Dehli. It consists of two stories, the first or basement consisting, as shown in the annexed plan, Pl. xv. of a number of small apartments which were possibly built for the very purpose they now answer, namely, that of assisting by the rent



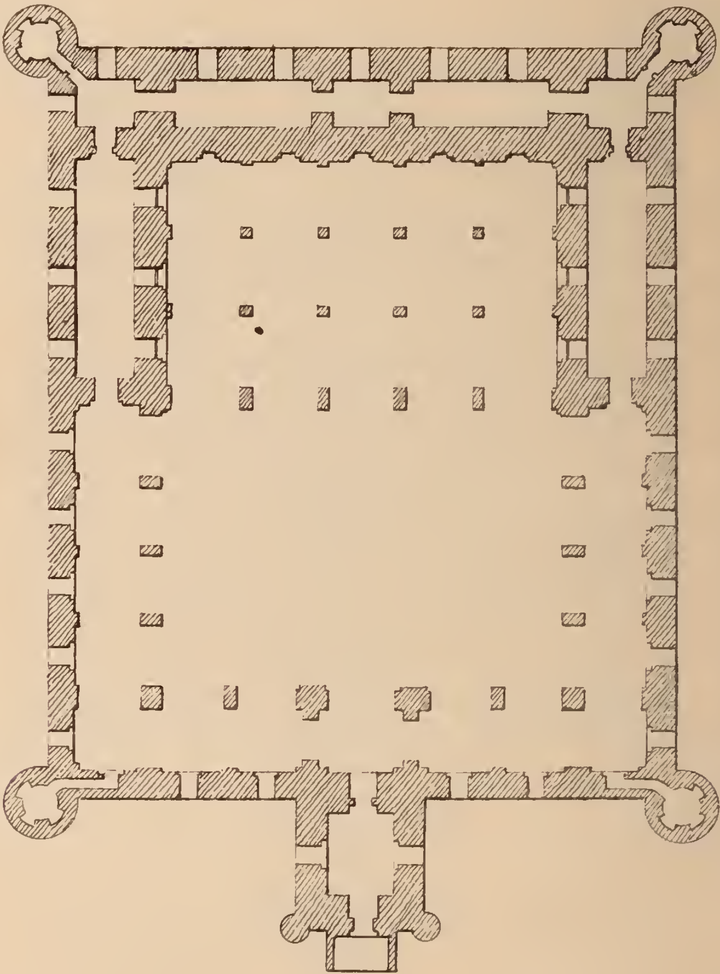
Basement Story   Kalán Musjeed.

Scale 10 20 30 40 feet

Reduced from Mr Cope's plan.

J.W. Laidlay.

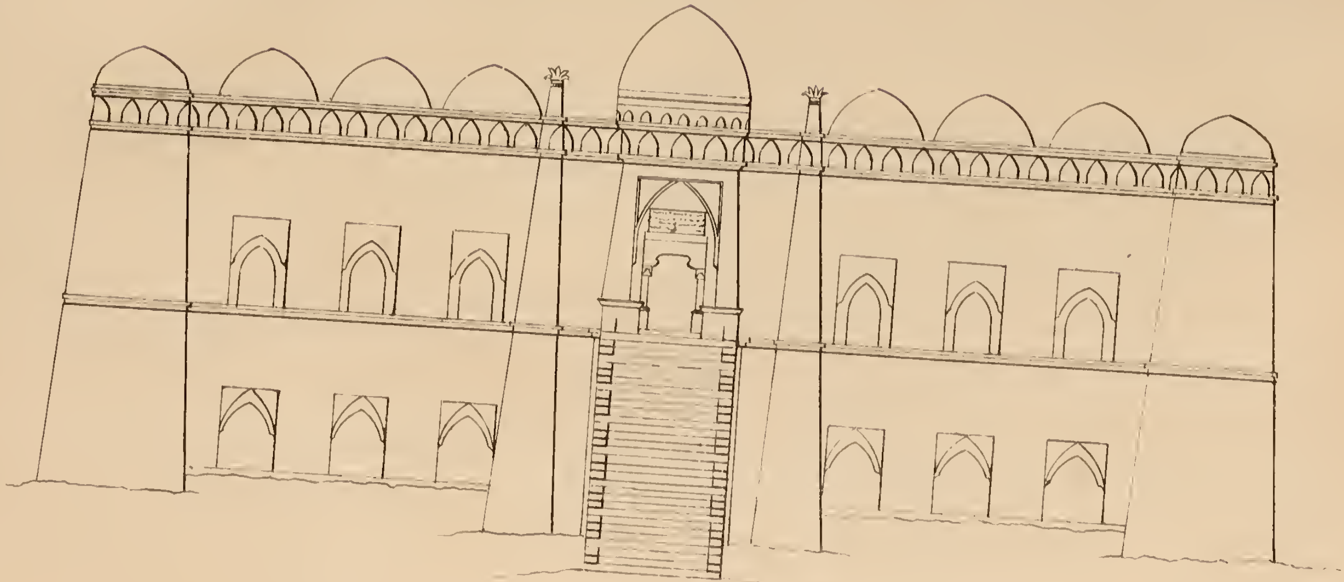
Pl. XVI.



Upper Story, Kalán Musjeed

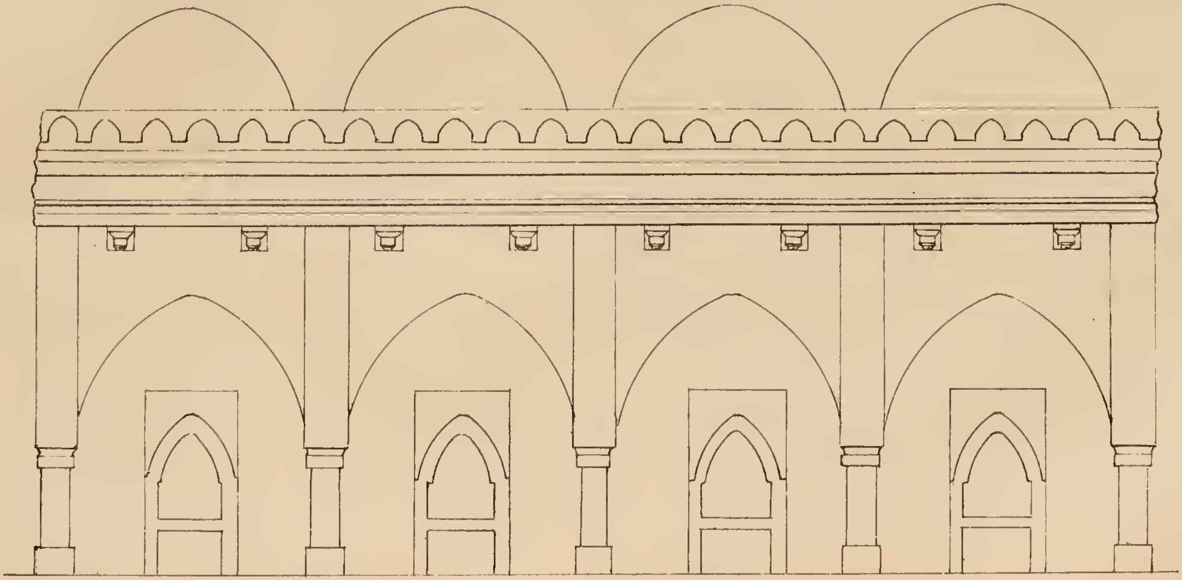
Reduced from Mr Scotland's plan.

T. Black Asiatic Lith. Press Calcutta



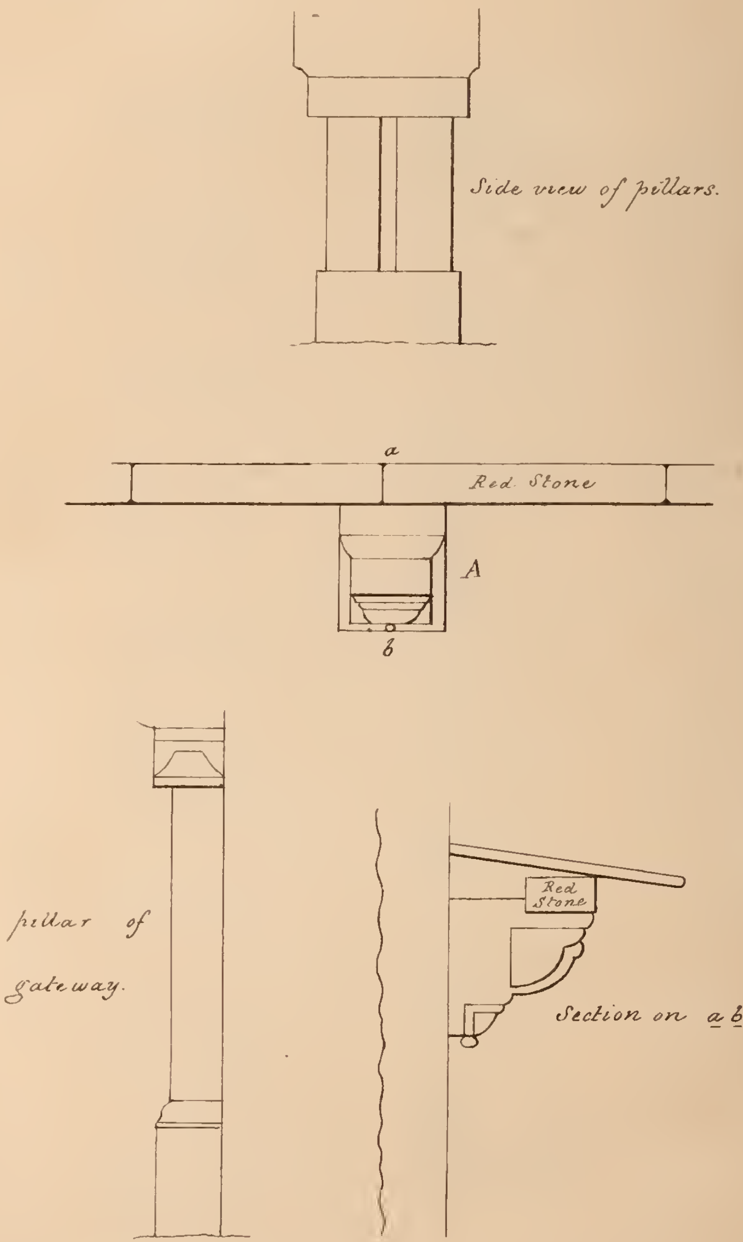
Front elevation of the Kalán Musjeed.

...duced from Mr. Lewis's sketch



Elevation Southern and Northern Clouster, Kalán Musjeed.

Pl XIX


Side view of pillars.
a
Red Stone
A
b
pillar of gateway.
Red Stone
Section on a b

they yield, in defraying the expenses of the mosque, in conformity with a practice prevailing to this day. The apartments along the walls are accessible by doors raised one step above the ground; those in the towers by passages from the neighbouring rooms. The upper story will be described hereafter. The mosque is built of the materials which appear to have been generally in use at the time of its construction, viz. the common quartzose sandstone found in the immediate neighbourhood of Delhi. This stone which is in masses of various sizes, some, especially those towards the foundation, being of considerable dimensions, is unhewn, and cemented by chunam of the best quality, indeed so excellent that the strength of the domed roof seems to depend entirely on its adhesive properties, there being no attempt at placing the stones of which it is constructed throughout, into any thing like the arrangement now adopted in the building of arches and domes, crowned by a centre or keystone. This cementing chunam, in this, and it is believed in all other buildings of the period, with a view probably of saving the expenditure of lime, is mixed with a great proportion of brick soorkee, of which many pieces are upwards of an inch in diameter. It will be curious to elucidate, by a series of observations, whether the bricks of which this soorkee was prepared, were made at the time, solely for the purpose of being mixed with the mortar, or whether they were remains of what had been used as the principal material in buildings of older date, and been discarded on the introduction, by the western people, of the use of tougher and less costly material, procurable in the neighbouring hills. The whole of the edifice, both inside and outside, has been plastered over with chunam of the best description, to judge by what remains; and parts about the doorway show that the outside has been at some time or other coloured of that peculiar blue-black produced by the ground charcoal of cocoanuts, and other similar substances. Very little, however of the plastering remains, except in the body of the mosque, where some care appears to have been taken for its preservation, (by repeated whitewashing,) and on the roof and domes which its durability has preserved from destruction. The whole is in a very fair state of preservation, and where, here and there, stones have fallen out, especially at the base of the towers and walls, they have been carefully replaced by brick masonry. The steps leading up to the entrance

door, and the pillars of the doorways and of the arches, are constructed of square roughly-hewn, hard, grey stone, described by Capt. Cautley, as only a variety of the quartzose sandstone more commonly in use in the walls, &c. which is also used for the eaves (slabs not above two inches thick and about two feet square) projecting into the upper inner square or court of the mosque, and for the brackets which support them. These brackets as well as the pillars at the doorways, are carved, as shown in the annexed sketches. Under the eaves, and resting on the brackets, is a ledge of the Roopas red stone, now so commonly in use throughout these provinces, but which seems to have been much more sparingly employed about the time of Feeroz than it was 80 or a hundred years before, in the Kootub Meenar, the Mote Musjeed, and other structures of the time of Shaháb-ood-deen and Shums-ood-deen Altumsh. The red stone is also used, (on account, presumeably, of its being softer and therefore more easily carved,) in the lattices of the windows, which are still open, and probably ornamented all the thirty-three windows which surrounded the upper story, some of which are now blocked up with the common stone masonry. There are also lattices of the same material between the main body of the mosque, and the vaulted passage leading on each side to the dark apartments behind, but none to the west. These lattices appear, notwithstanding their having been very well carved, to have been all covered with very fine chunam, after the fashion which prevailed to within the last hundred years, when the finely carved pillars, such as are standing in the ruins of the Koodseea Begum's Palace, built by the mother of Mahomed Shah (outside the Kashmeer gate) were similarly plastered over, to hide, it would seem, the piecings which here and there occur in the stone work. The stairs leading from below to the upper or main story are a flight of 29 steps, built upon three blind arches, with a landing place, and two more steps leading into the vestibule. Over the doorway, as exhibited in the sketch of the elevation, is a slab of somewhat rudely polished marble, with an inscription in the Nuskh character, of which the following is a copy in the common character of the present day :—

بسم الله الرحمن الرحیم بفضل و عنایت افریدگار درعهد دولت بادشاه دریندار
الواثق بتائید الرحمن ابوالمظفر فیروز شاه السلطان خلد ملکهٗ این مسجد

بناکرده بنده زاده درگاه جونانشه مقبول المخاطب خان جهان ابن خان جهان
خداے براین بنده رحمت کند هرکه درین مسجد بیاید بدعاء خیر بادشاه
مسلمانان و این بنده بفاتحه واخلاص یاد کند حق تعالی این بنده را بیامرزد
بحرمته النبي و الله مسجد مرتب شد بتاریخ دهم جمادي الاخر سنه تسع
الثمانین وسبعمائة *

(Translation.)

"In the name of God the merciful, the element, and in the reign of the devout king, strong by the help of the merciful God, Ab-ool-Moozuffer Feeroz, Shah-ul-Sultan; may his reign continue; this Mosque was built by the son of the slave waiting at the threshold, Junah Shah, exalted with the title of Khan Jehan, son of Khan Jehan; may God be merciful to him. Any one coming to this Mosque is required to pray for the chief of the Mussulmans, and for this slave with the Fateha, with earnestness, and with the hope that God may forgive him at the day of judgment. By the grace of Mahomet and his posterity this mosque has been finished on the 10th of Jumda-ool-akheer in the year of the Hijra 789."

It appears that the letters were first cut into the marble with small deep round holes in each letter, or limb of a letter, and that subsequently lead was poured into the cavities, and then polished off even with the surface of the marble, the small deep holes assisting in keeping the lead firm in its place. The greater part has, however, fallen out, with the exception of that in the vowel points, which are almost all perfect, and of two or three of the letters in the first and second lines. The entrance to the main body of the building is through a square vestibule with a domed roof, to which there were an outer and an inner pair of doors moving in sockets of a singular description, but common in the architecture of the times. The latter have disappeared, the former are still in existence, and to judge from their antique appearance, their most rude construction, and the very coarse iron work about them, it is fair to infer that they are of a very ancient date, if not coeval with the mosque itself. The famous Somnath gates must be at least 800 years old, these would be only 459, and though sál is probably not as durable as sandal-wood, to any one who may see these doors it would afford no great stretch of the imagination to believe that they were put up when the mosque was built. On passing the second doorway you enter a

cloister surrounding, on three sides, the inner court of the mosque. This cloister supports four domes on the north and south sides, and six on the east, the part next the entrance being covered with a nearly flat octagonal roof, of superior construction. In the part of the court next this square are three principal tombs, and a secondary one, in a row, built of brick and plastered over, three of men and one of a woman. The three first have each head-walls about three and a half feet high, with recesses for lamps, and altogether look so modern that it is difficult to believe in the correctness of the tradition which has it that Khan Jehan, the father, and Khan Jehan the son, are both buried here, though it should be remembered that the tomb, still in existence, over the remains of the founder of the Toghluk dynasty, is also of brick. There is no trace of an inscription which could afford the slightest clue to the truth or falsehood of the tradition. On the west side of the court is the main body of the mosque, consisting of a system of arches and domes, supported by six double and eighteen single pillars, including the pillasters against the walls on three sides. There are consequently five arches in front, and three in depth, supporting fifteen domes all, but the centre one, which is about three feet higher than the others, of the same height and dimensions. Round this colonnade, which would be decidedly imposing were the pillars only two or three feet higher, runs an enclosed passage, the use of which it is difficult to explain at present. It is dark and divided in the rear (to the west) being there separated from the mosque by a dead wall into three apartments, the centre one the smallest. In the inner wall of this passage, on either side and to the right and left of the door leading into it from the surrounding cloister, are flights of steps leading to the roof. They are, as usual in all buildings of that time, narrow, but not difficult of access, as is frequently the case. It seems premature at present to attempt any general conclusion on the nature of the buildings erected in the time of Feeroz, and the light they throw on the history of the period, there being so many other contemporaneous structures in the neighbourhood of Dehli, the examination of which must further elucidate the subject, but the following points regarding the Kalán Musjeed, the most perfect specimen of those times remaining, seem worthy of remark.

1st. The sloping style of the architecture seems peculiarly illus-

trative of the buildings of that, and earlier periods. The Kootub Minar is a well known instance of this style, as adopted about 100 years before the time of Feeroz, and the conical towers on each side of the entrance to the Kalán Musjeed are, in their general conformity, not unlike the famous Kootub Tower. The sloping pillasters on each side of the main entrance give somewhat of an Egyptian appearance to the front of the building, which is not dissimilar from some of the more ancient remains of Hindoo architecture, the style of which is generally believed to have been derived from the Egyptians.

It will be an interesting subject of future inquiry,—being a question which has not, that we are aware of, been yet decided, whether the Mahomedan conquerors of India preserved the style of architecture of the countries from which they emigrated, or whether they did not imitate to a certain extent the Hindoo buildings which they found in India.

2nd. The very simple kind of column and entablature used in this building as supports to the arches, is a point also very worthy of notice. It consists of one, or in most instances, two upright stones or pillars, standing on a third, with a fourth placed on the top as an entablature. This is one of the most primitive styles of architecture known. The peculiar construction of the arches and domes, the stones of which are held together by the wonderful adhesive qualities of the lime used in those days, without any key stones, has been before remarked upon, and is another characteristic of the Mahomedan Indian buildings of the 14th century.

3rd. It is reasonable to infer that this mosque was built in the midst of a considerable population, and that the present site of Dehli, was either a suburb of the then Feerozabad, or if not, a portion of that town itself.

It has been mentioned that the apartments on the basement story are occupied. The tenants pay to the collector of Dehli the monthly sum of Rs. 6-3, of which 6 Rs. are handed over to the attendant Priest appointed by the local authorities who, out of that sum, defrays the expenses of sweeping, and water, and provides the *budenees* in use by the few frequenters of the mosque, chiefly Affghans residing in the neighbourhood, to perform their ablutions. The balance of 3 annas per mensem is carried to the credit of the state, which is however, at the expense of any repairs which may be required.

As it is desirable, that a biographical sketch of the founder of any building illustrated should, where possible, accompany the detailed accounts which will, it is hoped, be laid from time to time before the Archæological Society of Dehli, with the view of comparing the architectural with the written records of the times, some account of Khan Jehan, who built the Kalán Musjeed, is here annexed, derived chiefly from Ferishta. The inscription explicitly mentions that the founder was the son of another Khan Jehan, and we find this assertion supported by the historian, who informs us that the first Jehan was, in the year of the Hijra 754, (A. D. 1349,) two years after the accession of Feeroz to the throne of Dehli, and in the 44th of his life, appointed Viceroy of Dehli, while the Emperor proceeded to Bengal on an expedition against Elias (Ilyas Khaje Sultan Shums-ood-deen Bengara).*

* Since the above was written we have been favored by Major M. E. Loftie, 30th N. I., with the following account of Khan Jehan the elder, extracted from the Tabakát Akbaree, which confirms the above, and furnishes still more ample details:

Extracts from the Tabakát Akbari, regarding Khán Jahán the elder, the wazir of Sultán Fírúz Shah.

"And in the year 754, after having hunted in (the district of) Kalánúr, he (Fírúz Sháh) returned, and, at the time of his return, he laid the foundations of some lofty buildings on the banks of the river Sarasutí. And he conferred upon Shaikh Sadru'd-dín, the son of Shaikh Bahau'd-dín Zakariya, the title of Shaikhu'l-Islam, and, having honoured Malik Kabúl, who was the deputy wazír, with the title of Khán Jahán, he made him the wazír of the empire."*

"And also in the month of Shawál, in the year 754, having invested Khán Jahán with the most ample authority, he (Fírúz Shah) left him in the city (of Dehlí), and departed with a powerful force for Lakhnautí, in order that he might put an end to the tyranny exercised by Ilyás Hájí, who, having assumed the title of Sultán Shamsu'd-dín, and founded (or enlarged) the city of Pandúá, had taken possession of the country as far as the confines of Banáras."

"After that, in the year 760, the Sultán (Fírúz Shah) marched towards Lakhnautí, leaving Khán Jahán in Dihlí, as vice regent during his absence."

"In the year 772,† Khán Jahán died, and his eldest son, Júnán Shah, received the title of Khán Jahán."

* According to Ferishta, Khán Jahán was appointed wazír, by Fírúz Sháh, in the year 752, when that monarch was advancing to the capital from the neighbourhood of Thatha (Tattah) in Sind, where he had been called to the throne on the demise of Sultán Muhammad Taghlik Shah. Sultán Muhammad died on the 21st of Muharram 752, and Fírúz Sháh arrived at Dihlí on the 2d of Rajab, the same year, having been 158 days upon the journey. On his way, he passed through the city of Ajúdhan (also called Pattan), in the province of Multán, where he visited the tomb of the celebrated Muhammadan saint, Shaikh Farídu'd-dín Shakarganj. From Ajúdhan, he moved to Hánsí, and it was upon the march to that city, that Malik Kabúl, waited upon him, and was raised to the dignity of prime minister, with the title of Khán Jahán. (See Ferishta, Bombay edition, p. 260). M. E. L.

† Ferishta says 774 (v. Bombay edition), and Dow gives the same date. M. E. L.

This officer, who was subsequently raised to the dignity of Wazeer of the empire, died A. H. 774, (A. D. 1356,) in the 22d of the reign of Feeroz, and was succeeded in his titles and office by his son, (whose name was Jonah Shah, according to the inscription, though that fact is not mentioned by the historian.)* In A. H. 787, the 13th of his Weezarut, and the 35th of his master's reign, it is said that age and infirmity began to press hard upon Feeroz. "Jehan, the Wuzeer, having the sole management of affairs, became very powerful in the empire. The emperor was so much under his direction, in all things, that he had the effrontery falsely to accuse Mahomed, the King's son, of a design against his father's life, in conjunction with several omrahs. He brought the old man firmly to credit this accusation, and obtained his authority to secure the supposed conspiraters." * * * "A party was sent to seize the Prince, who having previous intelligence of the design against him, began to provide for his security, placing guards, and fortifying himself in his palace. In this situation he remained shut up for some days; and at last, having obtained leave for his wife to visit the King's Zenana, he put on his armour, went into the close chair, and was carried into the Seraglio. When he discovered himself in that dress, the frightened women ran screaming into the emperor's apartment, and told him that the prince had come in armour with a treasonable design. The Prince having followed them, presented himself to his father, and falling at his feet, told him, with great emotion, that the suspicions he had entertained of him were worse than death itself. That he came, therefore, to receive it from his own hands. But first he begged leave to inform him, that he was perfectly innocent of the villainous charge which the Wuzeer had purposely contrived to pave his own way to the throne. Feeroz, sensible of his son's sincerity, clasped him in his arms, and weeping, told him he had been deceived, and therefore desired him to proceed, as his judgment should direct him against the traitor. Mahomed, upon this, went out from the presence and ordered 12,000 horse to be in readiness. With this body he surrounded the Wuzeer's house that night, who upon hearing of the prince's approach, put Ziffer (governor of Mahoba, lately imprisoned on the

* It is however in the Tabakát Akbaree, as will be seen in the extract translated by Major Loftie. We find that Ferishta himself also calls him Junah Shah, p. 256.

plea of his being one of the conspirators with the prince against the emperor) to death, and collecting his friends, came out to engage him in the street. Upon the first onset the traitor was wounded, and drew back to his house. He fled immediately towards Mewat and the prince seized all his wealth and cut off his adherents. Feeroz, *immediately after these transactions*, resigned the reins of government into the hands of his son, and abdicated the throne. The prince assumed the name of Mahomed (Naseer-ood-deen-ood Duneea), ascended the throne *in the month of Shaban* 789, and immediately ordered the Kootba to be read in his own and his father's name."—*Ferishta's History of Hindustan, translated by Dow, Vol. I. pp.* 311, 312).

From this detailed account by the historian it would appear that the Kalán Musjeed was finished by the Wuzeer Khan Jehan, only two short months, perhaps less, before his treason led to his downfal, his expulsion from the capital, and the loss of all his wealth, which fifteen years of unlimited power, under the declining energies of Feeroz, had doubtless made an object of desire to the prince who expelled him. His end was the end of most men in disgrace in those days. He had, it appears, taken refuge with a chief named Goga. On the appearance, in his district, of Sekunder Khan, a newly appointed governor of Guzrat, who was proceeding through Mewat to take possession of his office, Goga, fearing the resentment of the new emperor, seized Khan Jehan, and sent him bound to Sekunder Khan, who cut off his head, and forwarded it to Dehli. (*Ferishta as above*).* It is, therefore,

* Here again we are under obligations to Major Loftie for extracts from the Tabakát Akbaree, relating to the career and overthrow of Khan Jehan the younger :—

Account of the fall of Khán Jahán the younger, extracted from the Tabakát Akbari.

"In this year (787), the emperor (Fírúz Sháh) was greatly broken by infirmity and old age, and Khán Jahán, becoming possessed of unlimited authority, was desirous of getting into his hands the emperor's son, the prince Muhammad Khán, together with several of the nobility, such as Daryá Khán, the son of Zafar Khán, Malik Yaakúb, Muhammad Hájí, Malik Samá'ud-dín, and Malik Kamálúd-dín, who were friends and well wishers of the prince, and of depriving them of their power. He represented to the emperor, that the prince, in concert with the aforesaid noblemen, meditated a revolt, and Fírúz Sháh, putting faith in what he said, directed that the whole of those Lords should be arrested. Intelligence of this proceeding having been received by the prince, he absented himself for some days from the presence of his father. Khán Jahán then summoned Daryá Khán to appear before him, on the pretence of examining the accounts of the district of Mahoba, and (upon his arrival) confined him in his (Khán Jahán's) house. On hearing of this, the prince was filled with apprehension, and waited upon his father,

possible that his head may have been interred in the mosque beside the remains of his father, and that the tradition above alluded to might be considered as founded on fact, did not the appearance of the tombs themselves cast such a strong doubt upon it. We have, in the agreement between the dates of the historian, and that of the inscription, a confirmation of the accuracy of Ferishta in this part of his history at least, as it is scarcely likely that he ever saw or heard of the Kalán Musjeed, which must, in his time, (that of Jehangeer) have been outside the town of Dehli, surrounded, probably, by ruins, and as abandoned as it is now as a place of worship. Its massive solidity could alone have withstood the ravages of 459 years. In conclusion it may be remarked as a singular fact that a building of

whom he convinced of the treasonable designs of Khán Jahán. "He is anxious," said he, "to get rid of the principal members of the nobility, and after having removed them, he will turn his thoughts to the seizure of our persons." Upon this, the emperor ordered that Khán Jahán should be put to death, and released Daryá Khán from confinement.* The prince Muhammad now directed Malik Yaakúb to have the horses of the imperial stables in readiness, and also desired Malik Kutbúd-dín, the superintendant of the elephants, to draw up those animals, for the purpose of making an attack upon Khán Jahán. Towards the end of the night, the prince proceeded with a strong force against Khán Jahán, who sallied out of his house, accompanied by a few friends, and began to defend himself. At length, he was wounded, and his party being overthrown, he fled from the spot. The prince plundered his house, and put to death Bihzád-Fatah Khání, Malik Imadúd-daulat, Malik Shamsúd-dín, and Malik Masálih, who had fallen into his hands in the course of the fight. After these events, the emperor entrusted his son with the sole management of affairs, made over to him the insignia of royalty, such as horses, elephants, and followers, and conferred upon him the title of Násirúd-dín wa-ud-dunyá Muhammad Sháh (the defender of the faith and of the World, the emperor Muhammad). Fírúz Sháh then devoted himself to the service of God, and the duties of religion. On Friday, the Khutba was read in the name of both sovereigns—Sultán Muhammad Sháh mounted the throne in the month of Shaabán, in the year 789. * * * * On Malik Yaakúb he (Muhammad Sháh) conferred the title of Sikandar Khán, and he placed the province of Gujrát under his control. * * * * * Malik Yaakúb, on whom the title of Sikandar Khán had been conferred, was sent by Muhammad Sháh, with a large body of troops, against Khán Jahán. When this force arrived in the neighbourhood of Mewát, Kúká Chauhán,† seized Khán Jahán, and sent him to Sikandar Khán, by whom he was put to death, and his head sent to Muhammad Sháh.‡

* I think there is an error here in my copy of the Tabakát Akbarí, and that for "released Daryá Khán from confinement," we should read "directed that Daryá Khán should be released from confinement." Daryá Khán was, at this time, imprisoned in the house of Khán Jahán, and was subsequently (according to Firishta, by whom he is named Zafar (not Daryá) Khán, the son of Zafar Khán) put to death by the fallen minister, when the prince Muhammad Sháh attacked his house.—M. E. L.

† To whom, Firishta states, he had fled for protection.—M. E. L.

‡ This occurred in A. H. 789.

this kind within the precincts of a large and modern town, and prominently conspicuous from almost all parts of that town, should have been so little noticed by modern travellers. Bernier has not a word about it; it is not alluded to by Franklin, whose description of Dehli, in the fourth Volume of the *Asiatic Researches*, forms the staple basis of all subsequent accounts. It is possible however that descriptions may exist; if so the writers of this have not seen them, and can only hope that in such a case their account may be found to contain matter not previously touched upon by others.* They may further be permitted to express a hope that they will not be considered presumptuous in suggesting to other members of the Archœological Society of Dehli, the plan they have adopted in this paper with regard to other edifices around Dehli, by which a large mass of valuable illustrative information might be collected in a very short time.

We may state in addition that we have learnt, since the above was written, that several years after Dehli came into the possession of the British government, the principal Mahommedan inhabitants of the neighbourhood of the Torkman gate, who noticed with grief the neglect with which this mosque was treated by the king in whose charge it appears then to have been, presented a petition to the local authorities to restore the mosque to its original use; that their request received favorable consideration, that a grant, said to have amounted to Rs. 1500, was made to clean and repair the mosque, that the silk-weavers who had

* The following is the account, a very disparaging one, given of the mosque by Bishop Heber in the narrative of his journey :—"The Kala Musjeed is small, and has nothing worthy of notice about it but its plainness, solidity and great antiquity, being a work of the first Patan conquerors, and belonging to the times of primitive Mussulman simplicity. It is exactly on the plan of the original Arabian mosques, a square Court surrounded by a cloister; and roofed with many small domes of the plainest and most solid construction, like the rudest specimen of what we call the early Norman architecture. It has no minaret; the crier stands on the roof to proclaim the hour of prayer. —Vol. II. p. 297, 8vo. edit.

Hamilton, in his East India Gazetteer (2d edit. 1828) says of the Kalán Musjeed: "Besides these there are forty other mosques, some of which bear the marks of considerable antiquity. This applies more particularly to the black mosque, a large and gloomy edifice of dark-coloured granite, whose rude internal columns, cloistered area, numerous low cupolas, and lofty outer walls, devoid of aperture or ornaments denote an origin coeval with the earlier Affghan dynasties." [This last paragraph clearly shows that the inscription had not been read at the time the Gazetteer was published, because the reading would have left no doubt about the matter].

taken possession of it, were turned out, and that the arrangements now subsisting were then made for letting out the ground floor apartments so as to provide the means for keeping up at least the small religious establishment still provided.

Translation of an Inscription on a Gun at Moorshedabad with Remarks, by Major St. G. D. Showers.

I send you for insertion in the Journal of the Society a copy of a Persian inscription on a Gun at Moorshedabad. I forward also a translation of the inscription, with a sketch of the Gun. It is lying in a spot called the "Top-khanuh," which, with the "Qabuk-khanuh," in its immediate vicinity, took its name from the guns and ordnance stores collected here by the Nawab Mohabut Jung, otherwise called Uleevurdee Khan, when hordes of freebooters, known among the people here by the name of Burgees, (no doubt the Mahrattas,) roamed over the country in search of plunder. Several guns and some shot have been dug up and removed, and there are still two or three lying about or half buried in the earth. The gun on which the inscription is found is named the "Juhan Koosha," *the Subduer of the world,* and was probably brought by Moorshid Koollee Khan from Dhaka, where it was constructed, when he became invested with the administration of these Provinces. The following are the dimensions of the gun :

	ft.	in.
Extreme length, ...	17	8
Depth of bore, ...	15	3
From muzzle to 1st trunnion, ...	5	0
Space between the 2d trunnions, ...	5	0
From 2d trunnion to the breech, ...	5	0
Diameter of muzzle, ...	1	9½
Do. of bore, ...	0	6

It was made, as the inscription states, at Dhaka during the reign of the Emperor Shah Jahan, and is formed in the old style of welding together a series of rings over bars of iron. The art of casting cannon was known at Dehli as far back as the reign of the Emperor Babur,

but it is probable it had not reached so distant a province as Bengal, or the Juhan Koosha, a gun with which so much trouble appears to have been taken, would not have been constructed on the older and ruder method.

Islam Khan, the Viceroy by whose order the gun was constructed, is said, according to the author of the Siyur-ool-Mootakhureen, to have been appointed to the Government of Bengal 1047 of Hijree, corresponding to 1637 of our era, and was transferred to the Dewanee of the Empire at Delhi in the month Rujub 1049, or A. D. 1639.

The rest that is known of this Governor is succinctly mentioned by Marshman in his History of Bengal. I extract the passage, as it will be interesting in connection with the account of the gun:—

"In 1638 Islam Khan Mushmedy, an old and experienced officer, succeeded to the Viceroyalty of Bengal. In the first year of his Government, Mukut Ray, who held Chittagong for the Rajah of Arracan, rebelled against his master, and delivered it up to the Moguls. This port originally belonged to the independent kingdom of Tipperah: it was next conquered by the Muhammadans; but in the disputes which arose between the Afghans and Moguls, it fell into the hands of the king of Arracan. It was probably called Islamabad after the Governor who in this year acquired possession of it. Meanwhile the Rajah of Assam embarked five hundred boats on the Brumhapootra, and came down like a torrent on Bengal, plundering every town and village in the way. The Soobadar went out to meet him with his war boats armed with cannon. The Assamese could not withstand them. Their fleet was soon in flames; of the crew, a part fled to the shore, but four thousand were put to death. Islam Khan pursued them to their own country, and took fifteen forts and much spoil. It was also under his Viceroyalty, which lasted but one year, that Cooch Behar was invaded by the Muhammadans."

It will be observed there is a slight discrepancy between Marshman's account, and that in the Siyur-ool-Mootakhureen with regard to the date of the Viceroy's appointment to Bengal: but it is of little consequence, as it has probably arisen in computing the corresponding years of the Christian and Muhammadan eras, an error in such calculations being easily occasioned by mistaking the intercalary periods of the Muhammadan year.

To the naturalist and the general observer the "Juhan Koosha" is curious from the position in which it is lying. It is grasped by two trunks of a peepal tree, and supported by them about eighteen inches from the ground. Native tradition states that it was brought to the spot on a carriage, and was left there as the wheels sunk into the mud and could not be extricated. The tree must have sprung up under it, and the trunks as they grew, grasped the gun and continued to support it after the carriage had rotted away and fallen from under it. The back trunnion, on the opposite side from that whence the sketch is taken, is imbedded in the trunk and cannot be seen, but two stancheons and a ring are visible, which evidently belonged to the carriage. The front trunnion, with the iron work attached, was until lately also imbedded in the tree: but within the last six months a part of the trunk has been torn away by a storm, by which it has become exposed to view. The iron work on which the trunnion rested corresponds with the dimensions which may be supposed to be necessary to support so large a body on its carriage: and its bulk had no doubt so weakened the outer portion of the trunk as to make it yield easily to any force applied to it.

There is another peculiarity which it may be proper to notice as exhibiting a second phenomenon in the growth of the tree. There are two trunks that support the gun, but I am inclined to think they are branches of one tree. The trunk, obstructed in its growth, and pressed down by the weight of the gun, had first spread out under it; then forcing itself up one side and still hugging the gun, it met with a new obstacle in the trunnion, stancheons and the heavy iron work attached to them, and unable to press them aside yielded to the obstruction and parted and shot up in two large branches.

I cannot conclude this without acknowledging my obligation to Ensign Forster, of the 39th N. I. for the copy of the sketch I forward.

Inscription.

تبارك الله قلمرو مالك ساخت چو ستوده نام

خديو عرصهٔ دوران جناب شاه جهان يگانه ثانيء صاحب قران شه اسلام

بلند مرتبه توپی كه برسپهر برين نهاده پايهٔ اوگيتي از علو مقام

زصيت دولت وفال صلابت و هيبت باو فتاد زلازل بسورهای انام

بعهد معدلت داور ستوده سير   كه ملك اعظم بنگاله زو گرفت نظام

سحاب مكرمت اسلام خان عاليشان   كه بردرش بود اقبال چون كمينه غلام

چوگشت ساخته اين توپ اژدها تمثال   پی شكست عدو شهنشه انام

بجستم ازره انديشه سال اتمامش   رسيد — توپ جهان كشا الهام

توپ جهان كشا ساخت جهانگير نگر عرف ڈهاكه بداروغگي شير محمد ومشرفي هرليه داس وكاريگري جنار جن اهنگر ماه جمادي الثاني سنه ١١ موافق سنه مقرر وزن مارعـــه بوزن سي شش دام تل ثماري چوت ٢٨ ثار*

Translation of the Inscription.

The first couplet is illegible, but it is probably connected with the second.

"The Lord of the world! the great Shah Jehan
Unequalled—a second Sahib Qiran, the king of Islam.—
Such the dignity of this gun, that in the highest heaven
The times assigned it a station in the most exalted place.
From the report of its power, and omens dreadful and awe-striking,
The fortifications of the enemy shook as by an earthquake.—
In the time of the chief of noble qualities—
By whom the kingdom of Bengal was organized,
The cloud of beneficence, the famed Islam Khan,
At whose door prosperity waited as the lowest menial,—
When this gun of serpentine form was constructed,
For the purpose of destroying the enemies of the king—
I sought in the path of reflection the year of its completion,
Came* —— the "top Jahan Koosha" by inspiration.

The Gun Jahan Koosha was constructed at Jahangeer-nuggur, otherwise called Dhaka, during the Darogaship of Sher Mahommad, and when Har Bulleeah Das was Mashrif (Inspector), and Junar Jun Chief Blacksmith; in the month of Jumadee-oos-Sanee, in the year 11 † corresponding to the year 1047. Weight 212 maunds, the measure 36 dams til sumaree, charge of powder 28 seers."

* A word here elligible on the inscription.

† Of the reign of the Emperor.

Postscript on the Pigmy Hog of the Saul forest, by B. H. Hodgson, *Esq.*

Since my accouut of this rare animal was written I have had the great and unexpected good fortune to procure another specimen, a fine old male, which exhibits in perfection the characters of the species. I am still of opinion that the Pigmy Hog cannot be properly classed with the true Hog, or genus Sus, though the disparity is not so great as I was led to suppose. The following generic and specific characters will, I hope, accurately pourtray our animal in his general and special relations.

Pachydermata.
Suidæ.
Genus Porcula, mihi.

Generic character.—Teeth 44, as iu Sus; canines smaller and straighter. Facial bones coutracted in length and void of the peculiar nasal bone and cartilage of Sus. Fourth toe small and unequal. Tail rudimental.

Type, Porcula Salvania, mihi.
Pigmy Hog of the Saul forest.
Sáno Banél and Chota Savar of the natives.
Habitat, the Saul forest.

Specific character.—Pigmy Hog, of a medial brown colour, resulting from au irregular mixture of bristles wholly or partially black and sordid amber colour, the black part being generally basal and rarer. Young darker hued and unstriped. Iris hazel. Nude skin, dirty flesh colour. Hoofs glossy brown. Pelage ordinary, abundant, consisting of bristles. No mane. Tail not so long as the hairs of the rump, straight, nude. Length from snout to vent 22 to 24 inches. Height 10 inches. Weight 10 lbs, rarely 12. The scull of the Pigmy as compared with that of the common Hog is distinguished by a very considerable contraction of the great length of jaws proper to Sus, by a total absence of the special nasal bone and cartilage of that genus, by molar teeth carried back under the orbits so far as to exceed their posteal margin, by greater compression of the facial bones aud foramina, by zygomæ much less oblique or more horizontal, by smaller straighter canines, of which those of the lower jaw are very noticeably less divergent or more erect,

by orbits more nearly complete, there being distinct processes from the zygomæ as well as from the frontals, and lastly, by incisors unchannelled. The teeth are $\frac{6}{6}$, $\frac{1}{1}$:$\frac{1}{1}$, $\frac{7}{7}$:$\frac{7}{7}$ and agree with those of Sus save in the straightness and erectness of the canines of the lower jaw. The following are the dimensions of a fine old male.

Snout to vent,	2	0
Head to occiput,	0	$7\frac{1}{2}$
Tail,	0	$0\frac{7}{8}$
Hind leg, heel to hoof,	0	$4\frac{1}{4}$
Fore leg, elbow to hoof,	0	6
Length of ear to lobe,	0	$1\frac{3}{4}$
Mean height,	0	10
Snout to eye,	0	$3\frac{1}{2}$
Eye to ear,	0	$3\frac{1}{8}$
Girth behind shoulder,	1	$3\frac{1}{2}$
Length of fore hoof,	0	$0\frac{3}{4}$
Width of the same,	0	$0\frac{1}{2}$
Weight,	10lbs.	

Scull.

Length,	0	$6\frac{1}{4}$
Width, greatest,	0	3
Height, greatest,	0	$4\frac{1}{2}$
Front teeth to fore angle of orbits,	0	$3\frac{1}{4}$

Translation of the Inscription in the Nagarjuni Cave, given in Plate X. of the present Volume.

In compliance with the wish of our indefatigable friend Capt. Kittoe, we had the inscription given in Plate X. of the last number transcribed in Devá Nágárí and translated into English. It proves however to be no novelty; an English version having been published long ago by Wilkins in the second volume of the Asiatic Researches! As this work is inaccessible to many readers of the Journal, we think it right, having published a facsimile of the original, to reprint the Eng-

lish version, together with the Deva Nágarí transeript prepared by the Soeiety's librarian, Babú Rajendra Lal Mittra.

आसीत्सर्व्वमहीक्षितां मनुरिव क्षत्रस्थितेर्वर्द्धकः श्रीमान्मत्तगजेन्द्र तुल्यगमनः श्रीयज्ञवर्मा नृपः।। येनाहूतसहस्रनेत्रविरहक्षामास देवाध्वरे पौलोमी चिरमश्रुपातमलिनां धत्ते कपोलश्रियम्।। श्रीशार्द्दूलनृपात्मजः परहितश्रीर्येन संसृज्यते लोके चन्द्रमरीचिनिर्मलगुणो योऽनन्तवर्म्माभिधः। दृष्टादृष्टविभूतिकर्त्तृवरदम् तेनाद्भुतं कारितम् विम्बं भूतपते र्गुहाश्रितमिदम् देव्याश्च पायाज्जगत्।। मर्मान्ताकृष्टशार्ङ्गप्रविततसमरप्रस्फुरन्मण्डलान्त व्यक्तभ्रूभङ्गलक्ष्यव्यतिकरशवल स्वर्णवक्त्रेन्दुविम्वः श्रान्तयोऽनन्तवर्मा स्मरसदृशवपुर्जीवितानिस्पृहद्भिर्दृष्टः स्थित्वा मृगीभिः सविरलनिमिषस्निग्धसर्वेक्षणाभिः अत्याकृष्टाकुरङ्गवनितास्पर्द्धिनः शार्ङ्गयन्त्रादग्राविद्धप्रविततगुणोदीरितः सौष्ठवेन। दूरेप्रायी विमथितगजो ध्वस्तवाजिप्रवीरो वाणोरिस्त्रीव्यसन पदवीदेशिकोऽनन्तनाम्नः॥

1. The auspieious *Sree* YAJNA VERMA, whose movement was as the sportive elephant's in the season of lust, was like MANOO,* the appointer of the military station of all the ehiefs of the earth. By whose divine offerings, the God with a thousand eyes† being eonstantly invited, the emaeiated POULOMI‡ for a long time sullied the beauty of her eheeks with falling tears.

2. ANANTA VERMA by name, the friend of strangers; renowned in the world in the eharaeter of valour; by nature immaeulate as the lunar beams, and who is the offspring of *Sree Surdoola :* By him this wonderful statue of BHOOTAPUTI and of DEVI§ the maker of all things visible and invisible, and the granter of boons, whieh hath taken sanetuary in this eave, was eaused to be made. May it proteet the universe!

* The first legislator of the Hindus.

† *Eendra*, a deification of the Heavens.

‡ The wife of Eendra.

§ *Siva*, or Mahadev, and his consort in one image, as a type of the deities, *Genitor* and *Genetrix.*

3. The string of his expanded bow, charged with arrows and drawn to the extremity of the shoulder, bursteth the circle's centre. Of spacious brow, propitious distinction, and surpassing beauty, he is the image of the moon with an undiminished countenance. ANANTA VERMA to the end! Of form like SMARA* in existence, he is seen with the constant and affectionate, standing with their tender and fascinated eyes constantly fixed upon him.

4. From the machine his bow, reproacher of the crying *koorara*† bent to the extreme he is endued with force; from his expanded virtue he is a provoker; by his good conduct his renown reacheth to afar; he is a hero by whose unerring steeds the elephant is disturbed, and a youth who is the seat of sorrow to the women of his foes. He is the director, and his name is ANANTA.‡

Addendum to Capt. E. MADDEN'S *Notes of an excursion to the Pindree Glacier.*

The subjoined note which came to hand some time after Capt. Madden's interesting article had been printed, should have appeared at foot of page 246. Speaking of the Thakil palm, Chamœrops Martiana, Capt. Madden adds,—

"This Palm reaches the height of 30 feet, and is very abundant on the N. W. side of the Thakil mountain, where it flourishes from 6000 to about 7800 feet, along with Oaks, Maples, Rhododendrons, Yew, and Primula denticulata. I have also been informed that there are two tall specimens on the top of a mountain between Sutralee and Bagesur, to the right of the road, about three miles from the former place. Trewia nudiflora ("Toomree,") is found in the Turrai as far to the N. W. as Jounlasal, half way between Bhumouree and Burmdeo: to which point also reaches a semi-scandent Dalbergia, with pinnate leaves, apparently unknown further north, but very common towards Burmdeo. In the passes near this place, we find Thunbergia coccinea, "Kuljoka," in abundance; and Hardwickia binata, "Kuchlora"—attaining the size of a large timber tree. The Clematis Nepalensis of De Candolle (with an involucre) is abundant on the S. side of the Gaugur Pass, at the head of the stream called Jurra-panee, and apparently does not extend much further north: it grows at about 6500 feet elevation, and blossoms in December and January."

Capt. Madden further adds, that the kind of *shark* found in the Surjoo, called *gonsh*, is well know in the Ganges at Hurdwar.

* The Hindu Cupid. † A bird that is constantly making a noise before rain.

‡ Eternal, infinite.

PROCEEDINGS

OF THE

ASIATIC SOCIETY OF BENGAL,

May, 1847.

The usual monthly meeting of the Asiatic Society was held on Wednesday the 5th May.

The Honble Sir J. P. Grant, *in the Chair.*

The Proceedings of last meeting were read and confirmed.

The accounts and vouchers for the past month were submitted as usual.

The following gentlemen, duly proposed and seconded at the April meeting, were ballotted for and elected :—

Capt. J. C. Hanyngton,
Rev. Jas. Thomson.
G. Udny, Esq. C. S.
R. Thwaites, Esq.
M. E. Gibelin, of Pondicherry.
J. R. Logan, Esq.
James S. Blakie Scott, Esq.
Falconer Chute Sandes, Esq.
Warren H. Leslie Frith, Esq.
Robt. Thomas, Esq.

The following gentlemen were named as candidates for admission (to be ballotted for at June meeting).

R. O'Dowda, Esq., proposed by Dr. O'Shaughnessy, seconded by Lieut.-Col. Forbes.

Lieut. Thuillier, Bengal Artillery, proposed by Dr. Stewart, and seconded by Dr. O'Shaughnessy.

J. B. Elliott, Esq. C. S. Patna, proposed by Mr. Laidlay, seconded by Capt. Munro.

H. W. Elliott, Esq. C. S., Sec. to Govt. of India, proposed by Dr. Roer, seconded by Mr. Bushby.

John Johnstone, Esq., proposed by Mr. R. W. G. Frith, seconded by Mr. Laidlay.

Capt. Thos. Brodie, 5th N. I. Principal Assistant Commissioner, Sibsagur, Assam, proposed by Major Jenkins, seconded by Dr. Roer.

Lieut. Ed. Tuite Dalton, 9th Regt. N. I. Asst. to Comr. of Assam, proposed by Major Jenkins, seconded by Dr. Roer.

C. B. Skinner, Esq. proposed by Mr. Laidlay, seconded by Dr. O'Shaughnessy.

F. E. Hall, Esq. of Harvard College, United States, proposed by the Lord Bishop, seconded by the Rev. Mr. Pratt.

Read letters from Secretary to the Government of India, Home Department.

From G. A. Bushby, *Esq.*

Secy. to the Govt. of India, to Senior Secretary to the Asiatic Society Home Department.

Sir,—I am directed to acknowledge the receipt of your letter dated the 16th ultimo, and to state that the Society's application to be permitted to indent on the Hon'ble Company's Dispensary for a monthly supply of 10 gallons of Spirits of Wine for the preservation of specimens in the Zoological Museum, has been submitted to the Hon'ble the Court of Directors, under whose authority the present monthly payment of 50 Rs. is made to the Society for the cost of preparing specimens and maintaining collections of natural history.

2. I am at the same time directed to request you will place before the Society the accompanying copy of a despatch from the Hon'ble Court, dated the 17th February last, No. 5, in which they convey their acknowledgments for the contributions made by the Society to the Museum at the East India House, and request that specimens of new subjects illustrative of the Natural History of India, may be furnished as they are discovered and collected.

I have the honor to be,
Sir,
Your most Obedient Servant,
G. A. Bushby,
Secy. to the Govt. of India.

Council Chamber, the 24th April, 1847.

Public Department.
No. 5 of 1847.
Our Governor General of India in Council.

1. Our attention having been directed to the contributions which have been made to our Museum in this House by the Asiatic Society of Bengal, and particularly to the collections received in this country during the last five years, we desire to acknowledge the friendly co-operation of the Society in furtherance of one of the chief designs of our Museum, viz. the establishment in certain departments of a complete series of subjects illustrative of the Zoology of India. The collections which we have thus received and which with some others have been the results of public missions on behalf of Government, have supplied to the Museum most of the common subjects of Indian Ornithology, and specimens in other departments of Zoology, but in order to carry out the design, it is highly desirable that specimens of new subjects as they may be discovered and collected should be furnished to us without delay.

In expressing as we now direct you to do our acknowledgments to the Asiatic Society, for the valuable additions which from time to time have been made to our Museum through their instrumentality, and which are highly creditable to the Society's officers, it is our wish that you should bring to the notice of the President and Council of the Society, the importance which we attach to the early contribution to our Museum of newly discovered subjects illustrative of the Natural History of India, and upon this point we would refer you to our despatch of the 18th September, 1839, on the occasion of the provision by the Court of a salary for the Curator of the Calcutta Museum.

We are, &c.

London, 17*th Feb.* 1847.

(True Copy)

G. A. Bushby,
Secy. to the Govt. of India.

From the Secretary to Superintendent of Marine with Meteorological Register kept at Kyook Phoo for March.

From Lieut. Thuillier, Officiating Deputy Surveyor General, with Meteorological Register kept at the Surveyor General's office, Calcutta, for March.

From the Secretary to the Military Board requesting information regarding the Timber Trees of Bengal. The subject was referred, on the recommendation of the Committee of Papers, to Captain Munro, who was solicited to report upon it through the Committee.

From Captain Newbold, through Mr. Piddington, forwarding a notice by Hekekyan Bey, late President of the Ecole Polytechnique of Cairo, on the temples and emerald mines in the eastern desert of Egypt.

Captain Newbold also forwarded some minerals referred to in a memorandum annexed to the Bey's paper.

From Mr. Hodgson, Darjeeling, on the *Megaderme* of the Terai, with plate—on the *Pigmy Hog* of the Sál forest, with plate,—returning thanks for the Society's present of M. Csoma de Koros' Grammar and Dictionary of the Tibetan language,—and announcing despatch of the Preface to and first part of a series of Essays on the Aborigines of the Eastern part of the Sub-Himalayas and Terai.

From *Captain Hutton*, Mussoorie, 4th April, on the *Ovis Ammonoides* of Hodgson, and corroborating Mr. H.'s views regarding that animal.

From *Major Showers*, Murshedabad, with copy of a Persian inscription (and translation) on a gun found near Murshedabad, and which formed part of the train of Mohabut Jung, usually called Aliverdi Khan.

From Vincent Tregear, Esq. for copies of certain Oriental works, to be disposed of for the Society.

The Librarian was directed to comply with Mr. Tregear's wishes.

From Dr. O'Shaughnessy, reporting the Assay by the Assay Master, Mr. Dodd, of the Gold dust from the Beas river, forwarded by Captain Jas. Abbott, and which was found to contain in 100 parts.

			Assay Report.
Pure Gold.	*Silver.*	*Alloy.*	*C. Gns.*
91.015	2.995	5.990	$\frac{5}{8}$ Worse than standard.

On the Land Shells of the Tenasserim Provinces, by the Rev. F. Mason, A.M. (Ordered for publication.)

From J. G. Delmerick, Esq. forwarding some copper and silver coins found at Pertabghur.

[The copper coins sent by Mr. Delmerick are of no interest whatever. The seven larger ones are Juanpore coins of "*Husain Shah, bin Ibrahim Shah, bin Mahmood Shah;*" and are very common. The smaller ones are very much corroded; but have evidently Buddhist emblems.]

The *Report on the "Vedas"* (see May number) was brought up, having been circulated to resident members for consideration prior to the meeting—and the several propositions made by the Committee respecting the publication were unanimously adopted.

The following propositions by the Committee of Papers were submitted and unanimously agreed to :—

1. That *Hekekyan Bey*, late President of the Ecole Polytechnique of Cairo, on the recommendation of Capt. Newbold, seconded by Mr. Piddington and Mr. Welby Jackson, be elected an Honorary Member of the Asiatic Society, and preseuted with copies of their Researches, Journal and Oriental publications.

2. The Rev. Dr. Hæberlin having officially addressed the Senior Secretary, declaring his inability from absence, to take that part he would desire to do in the Society's proceedings, and tendering his resignation as member of the Committee of Papers and Oriental Section, the Committee of Papers renew their proposition of Baboo *Debendronath Tagore*, as a member of the Committee of Papers, vice Dr. Hæberlin.

3. The Committee of Papers recommend that Mr. G. Wilby be requested to act as a member of the Section of Mineralogy and Geology.

The usual monthly Reports of the Librarian and Curators were submitted.

Books received for the Meeting of the 5th May, 1847.

PRESENTED.

Meteorological Register kept at the Surveyor General's Office, for the month of March, 1847.—FROM THE SURVEYOR GENERAL'S OFFICE.

Ditto ditto kept at Kyouk Phyoo during March, 1847.—BY THE SECRETARY TO THE SUPERINTENDENT OF MARINE.

The Calcutta Christian Observer for May, 1847.—BY THE EDITORS.

The Oriental Baptist, Nos. 1 to 5.—BY THE EDITOR.

The Oopadeshak, a Bengali periodical, Nos. 1 to 5.—BY THE EDITOR.

Antiquarisk Tidsskrift, udgivet af det Kongeligc Nordiske Aldskrift-Selskab, 1843—1845, Anclet Hefte.—BY THE SOCIE'TE' ROYALE DES ANTIQUAIRES DU NORD.

Annaler for Nordisk Oldkyndighed, udgivne af det Kongelige Nordiske Oldskrift—Selskab, 1844-5.—BY THE SAME.

Americas Arctiske landes Gamle Geographie efter de Nordiske Oldskrifter, ved Carl Christian Rafn.—BY THE SAME.

Journal of the Royal Asiatic Society, Vol. X. Part I.—By the Society.

The Quarterly Journal of the Geological Society, No. 9.—By the Society.

Bulletin de la Société de Géographie, troisieme série, Tome V.—By the Society.

Exchanged.

Journal Asiatique, No. 39.

The London, Edinburgh and Dublin Philosophical Magazine, No. 199.

Purchased.

The Annals and Magazine of Natural History, No. 124.

The Edinburgh New Philosophical Journal, Vol. XLII. No. 83.

Journal des Savans, December, 1846.

The Birds of Australia, by J. Gould, F. R. S. &c. parts 24 and 25.

Tedelijkheid,—aan Maatschappelijk Belong,—*Aan* Bigbel *en* Evadgelie, Door S. A. Buddingh.—By the Author.

De Doodstraf, Getœtst aan Gezonde nede *en* Menschkunde, aan Godsdienst *en*.

Donations to the Museum.

List of Sculptures presented to the Society's Museum, by Capt. M. Kittoe.

Nos. 1 to 5. Buddhist Chaityas of different sizes.

6. A Chaitya with the Buddhist creed, " *Ye dharmaketu,*" &c. inscribed on its base.

7 to 10. Buddhist Chaityas without the inscription.

11. A Chaitya similiar to the No. 6th.

12. A *calasa* or pinnacle of a Chaitya.

13. A figure of Buddha, in black marble.

14. A figure of Buddha, in potstone.

15. A ditto.

16. A figure of Párbati.

17. Figures of Hara and Parbati.

18. A sculptured stone having a human figure in a niche.

19. A sow with seven pigs in bass relief.

20. A miniature figure of Buddha.

21. A piece of sculpture with four rows of Buddhist figures.

22. A ditto.

23. A ditto with 3 figures of Buddhas in niches.

24. A ditto with 5 figures of ditto.

25. A ditto with 4 figures of ditto.

26. A ditto with 4 figures of ditto.

27. The plinth of a Chaitya bearing 3 figures of Buddhas—a horse, an elephant, a " bo" tree, and the creed " *Ye dharmahetu,*" &c.

28. Ditto with 4 figures of Buddhas—without the inscription.
29. The plinth of a pilaster.
30. The base of a dodecagon pillar.
31 to 33. Three highly sculptured plinths of pillars.
34. Portion of the shaft of a highly sculptured pillar.

Report from the Curator, Zoological Department.

At this season of the year, it is rarely that I have much to report upon, at least as relates to donations received for the Museum; but the past has been a very busy month with me, and due progress has been effected in various departments of the Museum, to which I invite the attention of members interested in the investigations which fall within the sphere of duty of the Society's Zoological Curator.

1. From G. T. Lushington, Esq., of Almorah, have been received another skin of the *Ovis ammon,* and one of *Pantholops chiru.* The latter will, I think, bear setting up as a stuffed specimen;* but the former is, I fear, too much injured: though its head and horns may be preserved, as the horns present considerable difference from those of the specimen already mounted, and the two certainly tend to exhibit the amount of variation to which the horns of this noble species are subject. Those of the present specimen are remarkable for increase of depth, in inverse proportion to their diminished width at base; and I think I may now safely conclude my *O. sculptorum* to be a mere variety of *O. ammon.*†

2. From E. O'Ryley, Esq. of Amherst, has been received a collection of sundries, comprising mammalia, birds, fishes, *Crustacea,* and *Mollusca;* some of the *Crustacea,* more especially, being new to the Society's Museum, and especially acceptable. There is a particularly fine series of the *Ocypoda ceratopthalma,* from youth to maturity; from which it is seen that the remarkable ocular peduncle only begins to appear when

* This has since been done.

† In p. 362 ante, I was necessitated to quote from memory respecting the Prince of Canino's statement relative to the suborbital sinuses of *O. musimon.* But I find that I quoted it erroneously. It appears, on reference to the volume on "Goats and Sheep," in the 'Naturalist's Library,' that his Highness states (bearing out my own recollection of a living specimen), that "There is a trace of a lachrymal sinus;" and that the Prince referred this animal "to the genus or sub-genus *Capra,* on account of the absence of the *interdigital* hole." This further complicates the subdivision of the group of Wild Sheep.

this Crab is nearly a quarter grown. An equally fine series is sent of the common *Gelasimus* of the Bay, the half grown young of which Crab I have taken from holes in the bank only a few miles below Calcutta. We have received the same species from the Persian Gulf.

3. From Capt. Thos. Hutton, of Mussoorie, a large collection (the majority, however, sent on loan, and for the purpose of illustrating a paper which he has confided to my editorship), of the birds of Afghanistan, with many also from the Deyra Doon, certain of which have been presented by him to the Society's Museum.

4. From J. W. Payter, Esq., the skeleton of an adult Tigress.

E. Blyth.

Report of the Curator Museum of Economic Geology for the month of April.

We have received so little in the way of contributions this month that it is scarcely worth reporting upon, were it not to preserve the regularity of our reports; and my laboratory work of the month is not yet sufficiently advanced to enable me to conclude any paper or report as I desire.

Geology and Mineralogy.—We have received from Captain Kittoe a small box of specimens, but unfortunately without labels of any kind. Some of them require examination and will be referred to in a future report.

Economic Geology.—Capt. Sherwill has presented us with a box of specimens from the Mica quarries of Behar, of which he has promised a note. They consist of the mica in plates of all sizes, with quartz, felspar and tourmalin, and in one specimen small decomposing garnets.

Lieut.-Col. Ouseley has sent us a supposed mass of Coal from the Mohun River, Sirgooja, but it is rather one of a good Coal-shale with a vein of promising Coal running through a part of it. It is no doubt a surface specimen. The Mohun is a tributary of the Sone, taking its rise a little north of Sirgooja. The Sirgooja coal field is well known by the labours of Col. Ouseley as reported by the Coal Committee.

The thanks of the Society were unanimously voted for all contributions acknowledged as above.

[The following letter has been sent to the Editors of the Journal for publication as a sequel to the proceedings for May.]

To Dr. W. B. O'Shaughnessy,
Joint-Secretary of the Asiatic Society.

Dear Sir,—I had expected to have been present at the Society's meeting last night, but was unavoidably prevented almost at the last moment; it becomes necessary, therefore, that I should trouble you with a few lines in correction of such portion of your report of the Proceedings, published in April, as refers to what you supposed me to have said on the subject of the Burnes and Cantor drawings. You did me the favour to ask me to give you a written report of the remarks I made, but other engagements prevented my doing so; any trivial inaccuracy, therefore, I should not have noticed; but you make me talk nonsense on a matter of figures, and, however apparent it may be thought as a mistake, I desire to repudiate it. I could have wished that you had thought what I said on the subject of the importance of keeping accounts in a business-like way (with reference to the unsatisfactory abstract before me) worthy a line or two, prefacing as it did that "categorical mode of questioning" which you pronounced "uncalled for and unnecessary among a society of gentlemen." I think it would have been better, when you repeated this expression in type, to have mentioned the substance of my reply, which was, that the money matters of even a Scientific Society were of serious moment, and that peremptory questioning was called for by lavish expenditure and unsatisfactory accounts, more especially when there were not funds to meet its professed liabilities; you may remember that I pointed out, *inter alia*, that it was impossible for any member of the Society to say what sum, between two and three thousand rupees, was debited to 14 of Dr. Cantor's drawings. This brings me to the particular misconception of what I said about these and the Burnes lithographs, to which I have above alluded. The Report in the Society's Journal is as follows:—"The sets of Cantor's collection had cost Rs. 2561, being 183 Rs. each set—now he had much experience in the expense of lithographs and would pledge himself to produce plates infinitely superior to those now before the Society at the cost of from 5 to 10 Rupees per 100." How it could possibly have been supposed that I said one hundred lithographed *plates* could be produced for any sum between these limits, I am at a loss to imagine. I stated it was certain the 14 Cantor drawings had cost Rs. 2,561, but the precise amount beyond was undiscoverable, from Chinese zoology being lumped with Mr. Thoby Prinsep's bust and other matters, in an item of considerable amount. I said it was an exorbitant charge; that I had people in my employ who could lithograph much better, whose wages were Rs. 15 a month, and that each of them could certainly do

four or five of the drawings in that time. Mr. Piddington had dwelt on the enormous expense of colouring in this country, not dealing in figures but leaving the Society to infer that this item of expenditure might account for the outlay complained of. In reply, without denying that colouring was a very heavy expense, I stated that better colouring than was on the table could be obtained for from Rs. 5 to Rs. 10 per hundred drawings, and I left it to members to look at the accounts and make their own calculations.

You will see that this is a very different statement from the one published, and I shall therefore esteem it a favour if you will allow this letter to appear in the next number of the Society's Journal.

I am, dear Sir,

Your's faithfully,

James Hume.

Esplanade Row, May 6th, 1847.

Note.—The Editors willingly insert Mr. Hume's letter. Not pretending to possess the accuracy of professional reporters they applied to Mr. Hume for a correct statement of his remarks at the discussion regarding the "Burnes and Cantor drawings." Mr. Hume did not comply with their request and has accordingly suffered a most unintentional misrepresentation. As Secretaries, Dr. O'Shaughnessy and Mr. Laidlay have again to state prominently that they are in no degree responsible for any part of the expenditure referred to, all of which had been incurred prior to their appointment. The accounts, unpublished for several years, they printed as they received them from the late accountant. The Senior Secretary naturally objected to his being "peremptorily questioned" regarding accounts and transactions which Mr. Hume knew, he, Dr. O'S. had nothing to do with. When the accounts for this year are published Mr. Hume will be most welcome to question the Secretaries and Accountant as "peremptorily" as he pleases on every item they present. Pending publication, the accounts for each month are laid on the Library Table for the month ensuing, for the perusal of the members, who would confer a great favour on the Secretaries, and do good service to the Society by pointing out any irregularity in the expenditure or deviation from the rules laid down by the Society for the regulation of their outlay.